THURSDAY, DECEMBER 28, 1871

TECHNICAL EDUCATION IN HOUSE CONSTRUCTION

REFERRING to the recent sad events at Londesborough Lodge, and the disclosures made in the medical press, showing how the whole internal air of this house was tainted with sewer gas for want of ordinary care, the *Times*, in an able article which appeared on December 9, has the following telling passage: "What a satire on the universal diffusion of knowledge, on the lectures of the Royal Society, on hundreds of scientific and educational institutions, and all our new inventions and discoveries! Here is the simplest thing in the whole world, which wanted only common sense, and nobody seems to have thought of it—nay, we are not sure that our architects and builders will be thinking of it next year. It is far too simple and too deadly an affair."

We purpose to deal with this subject; and in doing so to show briefly how it is that with every apparent advantage our houses are still not altogether safe to live in.

In the first place, the whole subject of house-drainage has been thoroughly discussed, and simple rules have been laid down, which any one with ordinary technical skill can apply to any conceivable case.

The question has been treated in published reports by the Health of Towns' Commission, by the Metropolitan Sanitary Commission, by the General Board of Health, by the Barrack and Hospital Improvement Commission, by the Local Government Act Office, and recently, by the Army Sanitary Commission, for application in India. These official documents, extending over a period of nearly thirty years, contain all the principles on which wholesome house-conveniences can be constructed; and besides all this, engineering, architectural, and medical journals have never ceased to advocate attention to the requirements of healthy house construction. The Legislature, on its side, has been anxiously engaged in defining and granting every necessary power for the efficient carrying out of town-drainage works; but hitherto these powers have stopped short with the house drain. All between the head of the house drain and the interior of our bedrooms has been left to chance, or to the imperfect knowledge or no knowledge of such officials as we have seen defending the deadly arrangements of existing houses, or to plumbers' journeymen or apprentices. The whole experience shows that every official has considered his duty fulfilled when he had ensured an outlet for the refuse water of the house. As to the subsidiary traps, and such like things, they have been introduced without regard to scientific considerations; so that, instead of proving an advantage, they have, in some instances, increased the evil. Now, it must henceforth be recognised that house drainage is not a question of hydraulics merely, it is in a higher sense a question of pneumatics; but even in this extended sense it is far from being a difficult art, as some would have us suppose. It is by no means a "refuge of despair," as some have asserted. It is a great and beneficial necessity. Because carelessly-fitted water-pipes are burst by frost, and our houses are deluged every winter, are we to have a crusade against water supply? Bursting of water-pipes and the influx of foul air from sewers are indications of want of ordinary common sense; or, at all events, of very ordinary technical skill. And the real future question before us, is not whether we are to abolish household drainage and water supply, but whether some public control in these matters ought not to be exercised over the proceedings of plumbers' apprentices and other similar persons, so that when we rent or buy a house, we may be assured that typhoid fever, or some other pestilence, is not included in the contract. Every such contract should, however, ensure three things, viz., that water-pipes are protected from frost; that the house is thoroughly drained; and that no sewer-air can, under any circumstances, enter the house. Now all these things can be assured.

It is a mere truism to say that there are plenty of non-conductors of heat with which water-pipes can be efficiently surrounded. Why should water-pipes be left uncovered under flooring or in walls, as at present? Surely any local authority could deal with so simple, and, at the same time, so important a question as this.

As regards efficient drainage-pipes, traps, and the like, there are great manufacturing interests involved in the production of these, and any one who will cast an eye over the advertising columns of our architectural and engineering contemporaries, will see how much ingenuity and wholesome competition there exists in the production of the most scientific forms of apparatus of this class. But the missing link in the whole of these drainage arrangements is how to prevent foul air entering the house. In an ordinary second or third-class house in London, there are three or four water-closets, the main pipe from which enters the drain, either directly or through an inefficient trap. It may be safely stated that at all times there is more or less pressure of sewer air on the pan or trap of the closet, which must lead to an infiltration of foul air into the house. But nobody appears to have applied the long-known remedy for this, viz., to take off the pressure by a small leaden pipe carried from the upper end of the soil-pipe to the open air.

It is not, however, from the soil-pipe that most of the danger arises. Houses of the same classes have generally what is called a safe under the water-closet, from which safe a pipe passes directly to the drain. Next there may be a bath with its outlet pipe, its overflow, and the pipe of its safe, all connected with the drain. There may be three or even four sinks all connected with the drain, and then every cistern has its overflow, also connected with the drain. As these various open pipes are distributed all over the house, we can easily understand how, while fulfilling the function of removing waste water, they may, in conformity with the laws of pneumatics, distribute the most deadly poison among the unconscious sleeping inmates of every bed-room.

Foul sewer air returns into a house for the following reasons, viz.:—1. A wind-pressure exercised on the open mouth of a sewer perhaps many miles away; or a similar pressure exerted on an ordinary gulley grate. 2. By pressure of foul air into the house from the superior specific gravity of the atmosphere outside. 3. The draft of chimneys, when doors and windows are shut, as during the night. This draft must be supplied, and will supply

itself from every one of these small pipes, perhaps a dozen or more in a house, if it cannot be supplied more easily elsewhere.

The principles to be kept in view in dealing with defects such as those stated are obvious enough.

The general drain system of every street or district should be studied as regards its pneumatic relations, and means should be adopted for relieving the pressure within the system by ventilating outlets in safe positions. By placing charcoal strainers at all these outlets, sewer air would be deprived of its destructive qualities before passing into the streets. In special cases provision would have to be made for preventing the tide or strong winds from entering the mouth of the main sewer.

Then as regards the household drains. There is nothing easier than to ventilate the soil-pipes through charcoal filters in the manner stated. And as regards the numerous small pipes of sinks, baths, &c., not one of these ought on any account to communicate directly with a sewer. They ought all to be collected and allowed to discharge their contents in the open air over a trap communicating with the house drain, so that reflux of sewer gas into the house would be simply impossible.

Much evil has in times past arisen from imperfect drains within houses. Properly there should be none such. All connections of water-closets, sinks, baths, &c., with the house drain, should take place outside the house walls, and where from bad construction drains have been laid within houses and cannot be altered, they should be replaced by glazed earthen pipes laid in concrete, every joint made perfectly air-tight.

Cess-pits and traps ought never to be permitted within walls. The trapping should be all outside.

From want of attention to these long-known principles most of our houses are sick, and require separate diagnosis and treatment. They can all be cured if we only could find an authority to undertake the cure.

Were it not that in many instances we should have men of straw to deal with, we should feel disposed to advocate the application of Lord Campbell's Act to these cases. But as the recovery of damages would be a remote contingency, why should not Local Boards of Health, with their highly-paid health officers and surveyors, be required to see not only that all the details of water supply and drainage in new houses are safe, but that unsafe houses are made safe by their proprietors, or condemned as unfit for habitation?

After all is done, however, the chief remedy must be sought in technical training on all house questions in the application of which scientific principles are involved.

It may be safely stated that there is no technical subject of greater importance than this, and our recent experience has shown that there is no subject on which more training is necessary than to build a comfortable healthy dwelling.

SUTTON'S VOLUMETRIC ANALYSIS

Volumetric Analysis. By F. Sutton. Second Edition. (London: J. and A. Churchill.)

THE present volume is almost the only representative of a considerable branch of chemistry. We are surprised that Volumetric Analysis has not come into more general use amongst chemists, for the saving of time in most instances is very great, whilst for accuracy it frequently surpasses gravimetric analysis. Since the last edition of this work was published (1863), chemistry has made great advances; in volumetric analysis there has been a gradual extension and development, although nothing very new or startling has taken place during this period. This edition is a far more handsome volume than the last, the type and engravings being everything that can be desired. The author states in his preface that the new system of atomic weights has been adopted; the nomenclature also has been changed to a great extent, although we are sorry to find that the system adopted is by no means perfect. Thus we read of "the carbonates of lime, baryta, and strontian" (p. 26), whilst in a later part of the book such terms as "hydric chloride," &c., are met with. These of course are extreme cases; would it not have been better to have adopted some definite system throughout the book? We regret to say that the larger portion of the book is disfigured by a great number of small errors; for instance, the cross references in many cases are wrong, thus at page 80, the reader is referred to § 80, 2, for the determination of chlorides by Liebig's method, the paragraph referred to is an article "on the examination of raw phosphates and phosphatic manures." Again, we are told on p. 116 to refer to § 71 for the titration of phosphate, but this paragraph describes the estimation of sulphuretted hydrogen. We have noticed so many errors, some in formulæ, some in equations, and again in grammar, that, though making every allowance for printer's errors, we must conclude that the edition has been carelessly revised. There is one paragraph we should wish to call attention to, the first on p. 132, which we confess we have not been able to understand clearly. The number of new processes introduced is not large, nor are they of very great importance. We think, however, that methods such as the estimation of nitric acid by indigo might have been omitted, and that, for instance, the iron process for phosphoric acid might have been introduced. If Mr. Sutton would give, as far as possible, the precise cases for which each process is most suitable, we think the value of the book would be much increased. His long experience in these matters would render this addition of great importance, and would save much trouble.

Fifty-four pages of the volume are occupied by a description of the processes of water analysis (furnished by Mr. W. Thorp); this consists of a lengthy description of Frankland and Armstrong's process, which has undergone considerable modification, and a much shorter description of Wanklyn and Chapman's process. We look upon this part of the book as very valuable, for water analysis has now become quite a study, and such a clear and concise statement as that in the present volume will be found of great service to any one engaged in this work.

The last section of the book, consisting of seventy-four pages, is "On the Volumetric Analysis of Gases," contributed by Prof. H. McLeod. We cannot praise this portion of the volume too highly, the engravings are excellent, many of them we believe being from the original drawings of the author. We do not think that any student could do better than take this as his guide to gas analysis. It is the most clearly written and practical

account that we have seen in the English language, and we should be glad to see it still further extended by the author.

On the whole Sutton's "Volumetric Analysis" has certainly improved on the first edition, but with more care its value would have been much increased.

MORELET'S TRAVELS IN CENTRAL AMERICA

Travels in Central America, including Accounts of some Regions unexplored since the Conquest; from the French of the Chevalier Arthur Morelet. By Mrs. M. F. Squier. Introduction and Notes by E. G. Squier. (London: Trübner and Co., 1871.)

IN that portion of Central America which lies between Yucatan on the north and the city of Guatemala to the south, and bounded on the east by British Honduras, is a considerable tract of country which has remained almost unknown to Europeans since the Spanish conquest, and in which the traditions of the neighbouring States place vast aboriginal cities and wonderful enchanted lakes. To explore this region was the object of the adventurous expedition of M. Arthur Morelet, a French gentleman of leisure and extensive scientific acquirements. M. Morelet's natural history collections were deposited in the Museum of Paris, and described in the *Comptes Rendus* of the Institute; a new crocodile was named after him (which he pathetically declares to be the only result of the journey as far as fame to himself is concerned), and an account of his travels was printed for private circulation in his own country. In the volume before us a portion of this is now translated for the benefit of the American and English public. Although the work records no important or striking discoveries, it is a valuable and interesting contribution to the geography and natural history of an almost unknown district.

M. Morelet's journey was divided into two portions. The first was devoted to a visit to the ruins of the ancient city of Palenque, near the great river Usumasinta, in the western portion of the district. The existence of these ruins was not known till 1750, but they have been sufficiently described in the works of Dupaix, Stephens, and others. Notwithstanding the traditions of immemorial antiquity which hang around them, the author attributes their origin to the Toltecs, who, in the middle of the 7th century were in possession of Anahuac, where civilisation peaceably developed itself. Later, about the year 1052, they abandoned this region, and emigrated in a south-easterly direction, that is to say, into the provinces of Oaxaca and Chiapa. It is easy enough, therefore, he thinks, to arrive at the conclusion that Palenque was founded at this time, and was consequently contemporaneous with Mitla.

The second and more important portion of M. Morelet's expedition had for its special object a visit to the great lake of Itza, situated in the province of Peten. Although nominally within the territory of the Republic of Guatemala, and but a comparatively short distance from the British settlement of Belize, he was unable to obtain at any of the seaport towns of Yucatan any exact information as to the exact locality of, or the means of access to, this mysterious region. Proceeding from Palenque up the Usumasinta River, his route then lay eastwards for upwards of a fortnight through virgin forests of great magnificence, abounding in insects of all kinds, and in many rare and curious birds, and with a floral vegetation of great interest and beauty. The author describes in particular the *Aristolochia grandiflora*, with a flower often not less than twelve to fifteen inches in diameter, the calyx resembling the figure of a swan suspended by its bill, but when full-blown assuming the form of the conventional cap of liberty, turned up with a violet velvet lining, and worn by the Indian children as a helmet.

The great lake variously referred to by chroniclers as that of Itza, of the Lacandones, and of Peten, is described by M. Morelet as having a circumference of upwards of twenty-six leagues, and a depth in most cases exceeding thirty fathoms. It is not fed by any river, or even brook, of importance, and has no outlet; how its waters are kept fresh is not described. Its shores are defined by a girdle of broken calcareous hills, which are more or less silicious. On an island situated near its south-western shore is the Indian town of Flores, the only one of importance in this vast, almost uninhabited, district. Its description, and the illustration, convey an idea of great beauty:—

"I was impressed with the magnificence of the landscape which presented itself from the eminence where the modern church is situated, and which was once occupied by the ancient temples of the Itzaes. The sky was clear, the waters of the lake of the loveliest azure, and the islands and bluff shores, indented with little bays, hemmed in by silvery belts of sand, were green and refreshing to the sight. The island of Peten itself is oval in shape, rising by a gentle slope from the water, and terminating in a platform of calcareous rocks. It is not large; one may make the circuit of it in a quarter of an hour. Its surface is covered with small stones, which are doubtless the remains of ancient edifices."

The necessaries of life, both as to food and clothing, being very few in number, the inhabitants of Flores have little inducement to labour, and pass their days in luxurious idleness or nocturnal festivities, and their character is what might be expected from their habits of voluptuous ease, though without any strongly developed vices. As to the natural history of the district, the author describes as the most abundant mammalia three species of deer, the tapir, the peccary, a species of rabbit, an armadillo, the agouti, which commits great ravages on the crops, and several rodents. Among the birds he mentions particularly a small heron (*Ardea exilis*), two swallows, and a humming bird. Among the reptiles are a number of species hitherto undescribed, including a new turtle (*Emys areolata*) and the *Crocodilus Moreleti*, the capture of which nearly cost him his life. There are fifteen different kinds of fish in the Lake of Itza, which are almost without exception peculiar to it. Considering the isolation of the lake from all other water systems, this fact is of great interest to the student of the geographical distribution of animals, and of the origin of species. The flora is not described in detail, indeed throughout the book few plants are specifically named, unless of striking beauty or producing edible fruits. A suspicion of the accuracy of the author's knowledge of natural history is excited by the occurrence of such phrases, unless they be due to incorrect translation, as "invertebræ (*sic*) *and*

insects," speaking of a gasteropod as a "shell-fish," and describing the *Tillandsia* as "a variety of moss." Another serious defect in the book is that the map which accompanies it does not correspond with the text in the spelling of the names, nor always even in the natural features of the country.

From Flores M. Morelet proceeded in a southerly direction to the City of Guatemala, passing along the watershed which separates the streams flowing into Honduras Bay on the east from those which find their outlet in the Gulf of Mexico to the west. A halting-place on the route is the station of Campamac, laid down on the maps as a place of some importance, but which he found to consist of "half-a-dozen worm-eaten posts stuck in the ground in the midst of the forest, and supporting a thatched roof; a small clearing in front, and faint traces of a path leading to it in one direction, and from it in another." A little farther south, on approaching the Indian town of Cahabon or Cajabon, the traveller emerges from the dense virgin forests which have clothed the country since he left Flores, and enters on the wide open savannahs which characterise the southern portion of Guatemala. The Indians of this district belong to a different race from the Mayas of Peten; they are of a darker colour, with less regular features and less symmetry of form; with low foreheads, high cheek bones, and the top of the head rising to a point in a manner apparently artificial. The civilisation introduced by the Dominicans appears to be gradually decaying; and European vices, added to their own national indolence, are rapidly reducing their numbers, and deteriorating their character.

The reader will find in M. Morelet's narrative much valuable information as to the manners and customs of the inhabitants of an almost unknown territory, and with regard to the physical features and natural history of a country extremely rich in natural productions; interspersed with those personal incidents and tales of romantic adventure which add so much to the charm of a book of travel.

OUR BOOK SHELF

The Ornithology of Shakespeare. Critically examined, explained, and illustrated. By James Edmund Harting, F.L.S., &c. (London: Van Voorst, 1871.)

THE man who wrote the line, "One touch of Nature makes the whole world kin," demands that some notice should be taken in these columns of any one of his numerous commentators who may attempt to set forth that side of our versatile poet which turns towards natural history. Mr. Harting's attempt is eminently successful. We last met with him (not long since) "on the lone sea-shore," we now find he is equally at home in the library, and if he does not convince us that Shakespeare was a greater ornithologist than has lived since, proof at least is adduced that he was, in his knowledge of birds and their ways, inferior to no one of his time. Books have been written to show that our immortal bard was a soldier, a lawyer, and what not—his reputation as a keen and accurate observer of the feathered race is now fully established. How, indeed, could it be doubted? Did not the "swan of Avon" appreciate "the temple-haunting martlet" and the delicate air which it loved? Did he not "tune his merry note unto the wild bird's throat" while celebrating equally "the clamorous owl that nightly hoots," and "the plain-sung cuckoo grey?" But here we must stop. It is always the reviewer's business ("'tis true, 'tis pity, and pity 'tis, 'tis true") to point out defects. We may mention one. Mr. Harting has forgotten to notice the correct interpretation of the expression "russet-pated choughs," and urges the claim of the jackdaw to be the bird so distinguished. Now, as he truly says, the daw has a grey head, and to make Shakespeare term grey "russet" is, in our eyes, a crime. Without doubt the poet had in his mind the real Cornish chough, and the expression is quite accurate. "Russet-pated" is having red *pattes* or feet (*cf.* the heraldic *croix patée*); not a red *pate* or head—a feature equally inapplicable to chough or daw, while the red feet of the former are as diagnostic as can be. We are bound to say, however, that such a slip as this stands alone. Mr. Harting's book in general is not only readable, but exact and instructive, while its illustrative woodcuts are well chosen, well drawn, and well engraved.

Thoughts on Life-Science. By Edward Thring, M.A. (Benjamin Place), Head-Master of Uppingham School. Second edition; enlarged and revised. (London and New York: Macmillan and Co.)

THE first edition of this book by the accomplished and efficient head-master of Uppingham School appeared with the pseudonym "Benjamin Place" on its title-page; this second and much-enlarged edition bears the author's own name. The title may be apt to mislead some as to the nature of the contents; it is not a work on Biology. The author apparently means by "Life-Science" the science of those phenomena which are the manifestations of the higher kinds of life, as opposed to those sciences which deal with "matter animate and inanimate." "The world open to man's intelligence," he divides into two parts: "On the one side there is matter animate and inanimate, which as matter is capable of material investigation, and which is below man. On the other side there is life as displayed in feeling and thought, and belief founded on the facts of life. The science of this is Life-Science." Mr. Thring believes that man cannot live by science alone; that there is a kind of knowledge, a circle of belief, a region of activity, quite outside and independent of science strictly so-called, and which is of far more importance to the great bulk of humanity than any amount of scientific knowledge. To Mr. Thring, in the present "displacement of traditional ideas, it has seemed no useless task to look steadily at what has happened, to take stock, as it were, of man's gains, and to endeavour, amidst new circumstances, to arrive at some rational estimate of the bearing of things, to examine the instruments and means at our disposal, to examine our strength; so that the limits of what is possible, at all events, may be clearly marked out for ordinary persons." "This book is an endeavour to bring out some of the main facts of the world." Mr. Thring puts forward many statements regarding the inadequacy of language as a vehicle for thought, and on the imperfection of human intelligence itself at the present stage of man's progress, which claim the consideration of all those who are inclined to deny them; and much of what he says, as to the sphere and power of scientific research, deserves to be pondered by all earnest seekers after truth, and, indeed, has almost always been admitted by the highest intellects, who have tried to explore "the great ocean of undiscovered truth." Mr. Thring's style is characterised by a rugged force, and a certain novelty of expression and even of construction, which will render his book interesting to many readers, and which are frequently the outcome of his intense earnestness and the thoroughness of his convictions, as well as of impatience with those intolerant scientific specialists who imagine the little group of phenomena that comes within the ken of their limited vision to be the universe. We heartily commend the book to the attention of our readers.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Dr. Carpenter and Dr. Mayer

WITH reference to Dr. Tyndall's communication of last week, in which I most unexpectedly found a private note of my own placed before your readers, I should be obliged by your allowing me to state :—

1. That the idea of "Correlation," as originally entertained by Mr. Grove, and applied by myself to physiology more than twenty years ago, most unquestionably included that of the *quantitative equivalence* of the convertible forces, as will appear from the following passage in my memoir of 1850 (Phil. Trans. p. 731) :—"The idea of correlation also involves that of a certain *definite ratio* between the two forces thus mutually interchangeable, so that the measure of force B, which is excited by a certain exertion of force A, shall, in its turn, give rise to the same measure of force A as that originally in operation." And further I urged the *precise relation* observable between the vital activity of plants and cold-blooded animals, and the amount of heat they receive from external sources, as a ground for the belief that heat has the same relation to the organising force as it has to electricity (pp. 747-750).

2. In crediting Dr. Mayer therefore with the independent (and in my own case the previous) enunciation of the "Correlation" doctrine, I most certainly meant to include the notion of *quantitative equivalence*. Whether the quantities be or be not expressed in number seems to me a matter of secondary importance. WILLIAM B. CARPENTER

University of London, Dec. 26

The "North British Review" and the Origin of Species

THE writer of the article on the "Origin of Species," which was published in the *North British Review* for June 1867, has corrected in your periodical for November 30 an unimportant error which occurs in a certain paragraph of that article. There is, however, it appears to me, a much more serious error in the same paragraph, which vitiates his arithmetical calculations throughout, and leads him to an erroneous conclusion.

The paragraph in which this error occurs is quoted at length in Mr. Mivart's work on "The Genesis of Species." It may therefore be worth while to point out the oversight alluded to.

The error arises from the writer's assuming that in a race which remains constant in numbers, only one individual out of each family, *i.e.*, out of the offspring of one female, will on an average survive to produce young. This assumption is not true ; for since only one half of the race, namely the females, bring forth young, it follows that two out of each family must, on the average, survive to have offspring, namely, one male and one female. Each of these will transmit its peculiarities to its descendants.

I will now quote the writer's words, putting within brackets the necessary corrections.

He says, "A million creatures are born ; 10,000 survive to produce offspring. One of the million has twice as good a chance as any other of surviving ; but the chances are 50 to 1 against the gifted individual being one of the 10,000 survivors." Further on he says, "Let us consider what will be its influence on the main stock if preserved. It will breed and have a progeny of, say 100 ; now this progeny will, on the whole, be intermediate between the average individual and the sport. The odds in favour of one of this generation of the new breed will be, say, $1\frac{1}{2}$ to 1, as compared with the average individual ; the odds in their favour will therefore be less than that of the parent, but owing to their greater number the chances are that about $1\frac{1}{2}$ of them would survive [*about* 3 *of them*, for without any advantage two would on an average survive.] Unless these breed together, a most improbable event, their progeny would again approach the average individual ; there would be 150 [300] of them, and their superiority would be, say in the ratio of $1\frac{1}{2}$ to 1 ; the probability would now be that nearly two [$6 \times \frac{5}{4}$, or nearly 8] of them would survive, and have 200 [750] children with an eighth superiority. Rather more than 2 [15] of these would survive ; but the superiority would again dwindle, until after a few generations it would no longer be observed, and would count for no more in the struggle for life than any of the hundred trifling advantages which occur in the ordinary organs."

The writer thus concludes that the advantage derived by inheritance from the sport will ultimately die out. The true conclusion is, that the advantage never dies out, but only becomes distributed through the whole race ; and, moreover, that the sum of the advantages of all the favoured individuals, when added together, is greater than the original advantage, and becomes greater and greater every successive generation, though it tends to a limit at which it never actually arrives. Thus, representing the original advantage by unity, the advantage in the next generation is $1\frac{1}{2}$, in the next $1\frac{7}{8}$, and so on.

If now the same kind of sport arise independently, (*i.e.* not by inheritance from some previous sport) say once in every generation, and is preserved, say once in every fifty generations, the advantages derived by inheritance from these sports will accumulate and become distributed throughout the whole race. Hence in the course of an immense number of generations they must produce a decided effect upon the character of the race.

Thus, though any favourable sport occurring once, and never again, except by inheritance, will effect scarcely any change in a race, yet that sport, arising independently in different generations, though never more than once in any one generation, may effect a very considerable change. These conclusions are opposed to those which the writer of the article is endeavouring to establish.

Leeds Grammar School A. S. DAVIS

Prof. Tait on Geological Time

As I have lately found, under the signature of Prof. Tait, in the well-known *Revue Scientifique*, several statements that would doubtless have been challenged had they appeared in any English scientific journal, and of which the following are specimens :—"Sir W. Thomson has already demonstrated, by three complete and independent physical proofs, the impossibility of admitting the existence of such periods"—"Each one (of Sir W. Thomson's arguments) would suffice to upset at once the pretensions of Lyell and Darwin"—"Professor Huxley's attempt has completely failed ;" and as in the new edition of Juke's Geology Sir W. Thomson's demonstration is stated at some length, while an adverse argument used by Jukes is omitted, I venture to ask that you will allow me a few words on the subject, since I treated the matter at length two years ago in *Scientific Opinion*, and, so far as I am aware, my arguments remained unanswered.

1. Does not the conclusiveness of all Sir W. Thomson's arguments depend upon the assumption of the universality of the principle of dissipation of energy? But to assume this is to assume that uniformitarianism is false. The whole question is therefore begged in the premisses, as must be the case in mathematical arguments.

2. As Mayer categorically denies the universality of the said principle, by what right does Sir W. Thomson entitle it a "principle of natural philosophy," and therefore state that uniformitarians are "directly opposed to the principles of natural philosophy"? As in the opinion of the French Academy, and of many eminent English and German savants, Mayer is one of the first physicists in Europe, I think it cannot be assumed with Prof. Tait that, "as regards method, Mayer and his supporters are little in advance of the Middle Ages," though undoubtedly Mayer is very different from Sir W. Thomson.

3. By what process does Sir W. Thomson discover "universal principles?" His universal principle regarding the origin of life "true through all space and all time," affords an opportune answer to this question. I would simply refer to Mr. Ray Lankester's article on that principle (NATURE, No. 97, p. 368), and ask if any one can discover a more satisfactory foundation for the *universal* principle of dissipation. From long study of Sir W. Thomson's reasonings, I conclude that he will reject any evidence for spontaneous generation, in consequence of the "universal principle" he has assumed on that question.

4. In Section A of the last British Association, Sir W. Thomson supported his argument regarding the form of the earth (controverted in your pages by Mr. Croll) by referring to existing mountains five miles high (see *Athenæum* report). His audience must have understood that these mountains are primæval, as otherwise the argument would have had no meaning. But as this is the reverse of the truth, I cannot help saying that Sir W. Thomson appears to consider himself entitled, not merely to invent principles, but also to invent facts. I know no conclusions of

science that might not be "briefly refuted" by such a method; but I think it would be fair to employ the words, "particular opinions of Sir W. Thomson" in place of "principles of natural philosophy," and "imaginary consequences of these opinions" in place of "facts." If this were done, all would admit that Sir W. Thomson's arguments are conclusive demonstrations; granted the premisses, the conclusions certainly follow. But geologists have simply to assume the contrary premisses, and they may mathematically demonstrate the reverse. Agree to beg all the difficulties of a question, and a certain conclusion may easily be obtained. This fact was recognised in the Middle Ages, and Mayer has not got rid of it.

P. W. STUART MENTEATH

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[The remarks of Prof. Tait are contained in his opening lecture for Session 1869-70, which was sent to us with permission to make what use of it we chose. As the matter of Geological Time had been very fully discussed in this country, we did not insert the portions bearing on it. We believe that the portion which we did insert induced the editor of the *Revue* to apply to the author for the whole MS. As to the queries in the above letter we may note,

1. The Dissipation of Energy is a necessary consequence of the second law of Thermodynamics.

2. If "Mayer categorically denies its universality," so much the worse for his own credit, and for that of "the French Academy and the eminent English and German savants" who support him.

3. It is not for us to say what Sir W. Thomson would, or could not, do.

4. So, after all, Mayer seems to be no better than Sir W. Thomson.—ED.]

In Re Fungi

IT may allay the alarm of your correspondent "W. G. S." as to the decay of fungology in England, as far, at least, as one of the cases which he quotes is concerned, to be informed that so careful and critical a student of fungi as Mr. W. G. Smith confirmed the determination referred to, and on the faith of the abnormal specimen, included this rare and very critical species without any hesitation among the Middlesex fungi in the "Middlesex Flora," p. 408. Your correspondent "W. G. S." has missed the point of the paragraph from the *Journal of Botany* which he criticises. The specimens of this fungus collected by Mr. Wooster at Whitehall Gardens have a regular and normally developed pileus, and were in striking contrast to the "abnormal specimens" (W. G. Smith, *l. c.*) from the Goswell Road.

F. L. S.

A Shadow on the Sky

I DO not know how common is the phenomenon described by Mrs. Charlotte Hall in NATURE of Nov. 9 (p. 25), but her communication leads me to report a much less striking appearance of the same kind, which I witnessed Feb. 20, 1870, in this neighbourhood. I was taking an early walk, and had mounted to the top of a ridge commanding an eastern view, about fifteen minutes after sunrise. The sky was veiled in a dark white. Above me, a little to the south and east, hung a ball of vapour in mid-air, warmed into smoke-colour by the rays of the sun, and yet so dense as to cut off these rays, and cast a rectilinear shadow of dark blue against the white coat of the sky. The shadow was sharply defined, and the whole effect was not unlike the nucleus and tail of a comet. In a few moments the shadow faded out, and, shortly after, the ball itself was dispersed. The moon, in its third quarter, was visible somewhat past the zenith, and surrounded with vapour. Twelve hours later we had a violent rainstorm.

N. J.

New York

Coal Measures of Ireland

IN the new edition of Jukes's "Manual of Geology," by Prof. Geikie, at page 592, it is stated, on the authority of Mr. E. Hull, that "in Leitrim, Fermanagh, and Tyrone, there are true representatives of the Yoredale series of England." I, however (as also the late Mr. Jukes), contend that no comparison can be drawn between the coal bearing rocks of Ireland and those of England. Furthermore, as Mr. Hull is unacquainted with these Irish rocks, having only seen a few isolated patches of them, I protest against his being quoted as an authority on the question, more especially as in the paper to which Mr. Geikie referred, "On the Geology of the Ballycastle Coal Fields, &c.," Mr. Hull states that while in the counties above mentioned there are true coal measures, in the provinces of Leinster and Munster there are none—a statement quite contrary to facts, as all the sections of these rocks in Leinster, Munster, and Connaught are identical, and probably, as suggested by the late Mr. Jukes, were once connected, as the lowest bed of coal occurs everywhere at a nearly equal height above the limestone. Furthermore, the intervening strata are nearly identical, there being a certain thickness of argillaceous beds below, next the limestone, and a mixture of arenaceous and argillaceous beds above.

Naturally it may be expected in all places where a sea gradually became shallow, that limestone would be succeeded by fine argillaceous beds, the latter by shore beds, more or less coarse and arenaceous, and eventually by land beds, such as coal, fire-clay, clunch, and the like.

Similar sequences are not uncommon, both on a large and small scale. On the large scale in the passage rocks from the limestone to the coal-bearing rocks of most countries, and on a small scale in the north of Ireland and in Scotland, where a bed of limestone will be succeeded by a shale, the shale by a sandstone, and the latter by a clay or coal.

If we examine into the thickness of the English and Irish rocks, the difficulty of a comparison is apparent. In the latter country the greatest thickness of the rocks called coal measures never exceeds 3,500 feet, this series of strata including all the rocks above the limestone; whilst in Lancashire, according to Mr. Hull's sections, the Yoredale beds alone exceed 5,000 feet in thickness.

Moreover, if any value is to be attached to palæontological evidence, we find that from the base upwards in the Irish rocks there are fossils which in England are considered to be characteristic of the true coal measures. The latter fact would seem to suggest that while in Ireland the upper part of the limestone was being deposited, in England the millstone grits and Yoredale rocks were accumulating, whilst subsequently, in both countries, true coal measures were deposited; those in Ireland being unfortunately very poor in coal, although containing very similar fossils.

In the northern extremity of Ireland, and in Scotland, the measures are very similar, and in certain places apparently identical, as pointed out years since by Sir R. Griffith. This, therefore, is no new fact, as Messrs. Hull and Geikie would suggest to their readers.

G. HENRY KINAHAN

Recent Changes in Circumpolar Lands

SOME years ago I wrote a paper for the Ethnological Society on some changes of surface affecting Ancient Ethnography. Since this was printed many facts have accumulated. These have led me to a tentative generalisation on the subject, which I should like to have discussed in your pages.

The question of the upheaval and subsidence of different areas of the earth's surface, as it is going on at the present moment, is of very great importance in geology, and yet few subjects have been more neglected. A few facts have been here and there collected; but even the best authorities treat the matter in a jejune fashion. According to them the areas of upheaval and subsidence are scattered over the earth's surface in an irregular manner, without any definite law or rule. I believe that with very slight local exceptions there is a very distinct law which governs the subject.

Putting aside altogether the southern hemisphere for the present, I wish to prove that the area of upheaval is confined to the land bordering the Polar Sea, and to the Polar Sea itself; that it is perfectly continuous all round the earth, and that it is greatest near the Pole, and gradually diminishes until it disappears about the 57th parallel, leading to the conclusion that the focus of upheaval is the Pole itself.

Of course, my observations are entirely confined to what is taking place *now*, and are not to be confused with the facts of any other period, historical or geological.

Commencing with Scandinavia, we have the remarkable testimony of Pliny, Mela, Solinus, and others, to the fact that Scandinavia was considered by the Roman geographers, whose authorities were bold and expert seamen, to be an archipelago. Ptolemy speaks of the Scandian Islands. The very name Scandinavia is evidence that those who used it looked upon it as an

island. This implies that a great deal of dry land must then have been under water. In 1834 Sir Charles Lyell wrote his Bakerian lecture, in which he brought forward overwhelming evidence to prove that Scandinavia was then being gradually upheaved. Celsius, who wrote in the 17th century, had affirmed it, and calculated the rise at forty inches in a century. In 1807 Von Buch wrote that all the country from Frederickstadt, in Sweden, to Abo, in Finland, and perhaps as far as St. Petersburg, was slowly rising. Other authorities concurred, and lastly Sir Charles Lyell, who had approached the subject as a sceptic, was fully convinced after an exploration of the ground. At Stockholm he found striking proofs of change since the Baltic acquired its present tenants, Testacea found there seventy feet above the sea level being identical with those found in the adjacent sea. At Soderleige, a little farther south, and in a bed ninety feet above the sea level, besides the shells were found several buried vessels, made of wood, and joined with wooden pegs. In another place an iron anchor and nails were found. At Upsala brackish water plants were found in meadows where there are no salt springs; a proof that the sea had only recently retired. At Oregrund, forty miles to the north, the land had risen five inches and a half since 1820, and at Gefle were low pastures, where the inhabitants' fathers remembered boats and even ships floating. Experienced pilots in the Gulf of Bothnia estimated the fall of the waters at two feet in thirty years. Since Sir Charles Lyell's lecture both the Russians and the Swedes have made experiments all proving the same fact.

To the east of Scandinavia we have Finland, exhibiting all the characteristics of a recently-emerged land. It is a mere congeries of lakes and swamps, separated by moss and sand. The level of the lakes is constantly falling. In 1818 Lake Sovando was suddenly lowered; its waters escaped into Lake Ladoga, and much of its bottom was exposed. Similar traditions about low meadows but recently crossed by boats and ships to those existing in Sweden prevail here also, and there seems good ground for believing that in the days of the Norsemen the White Sea and the Gulf of Finland were joined by a considerable strait. Farther east, again, we have the experience of Murchison and his companions, who found on the banks of the Dwina and Vaga recent shells still retaining their colour, and of the same species as those found in the Arctic Sea. In Spitzbergen, Mr. Lamont reports (see vol. xviii. of the "Quarterly Journal of the Geographical Society") that he discovered recent bones and drift wood several miles inland and high above high-water mark, skeletons of whales thirty to forty feet above the sea level. The seal fishers told him the land was rising, and that the seas thereabouts were now too shallow for the right whale, which had forsaken the Spitzbergen coast. This is confirmed by Malmgren (see Petermann's *Mittheilungen*, 2, 1863). Farther east we have the Tundras between the Karen Sea and the Gulf of the Obi presenting bare desolate flats that look as if they had only recently emerged. Middendorf describes the surface of the great Siberian Tundra as coated with fine sand like that now being deposited by the Polar Sea. Von Wrangel has many useful remarks to prove my position. He tells us that Diomed Island, mentioned by Laptev and Schalaurov, is now joined to the mainland; the coast of the Swatoi Ness, which they describe as very indented and ruinous, is now straight. The Bear Islands are mere heaps of ice and stones, evidently but recently covered with water; and shoals and banks now occupy what was tolerably deep water in 1787 when Captain Sarypchew was there.

Herdenstrom, in 1810, found large birches scattered about the Tundra, 3° to the north of any known Siberian forest; probably drift wood such as Wrangel himself found drifting in the Polar Sea. Whales have now almost deserted the Siberian shores, where in the eighteenth century they were common. This is, no doubt, due to the shallowing of the water, as is the case in the Spitzbergen Sea. The shores of the Polar Sea, from the Lena to Behring's Straits, are for the most part low and flat. In winter it is hard to say where land ends and sea begins. A few versts inland, however, a line of high ground runs parallel with the present coast, and formerly, no doubt, constituted the boundary of the ocean. This belief is strengthened by the quantity of drift wood found in the Upper Level, and also by the shoals that run out, and will, no doubt, become dry land (*Vide* Wrangel's Introduction). "At several places along the coast we found old weathered drift wood at the height of two fathoms above the present level of the sea, whilst the lower drift wood lay at a level, indicating a change of level." Moving farther east again across Behring's Straits, we find Captain Beechey describing the coast as a high cliff, now separated from the sea by low flats with bones, &c., on them. I cannot speak with the same confidence of the vast archipelago that bounds America on the north, nor about the northern shores of America, my researches having been confined to Asia, but evidence must abound in the Arctic voyages. Drift wood and bones of whales are mentioned on high ground by several of them. If it be permitted to quote the works of M. Reclus as an authority, and I believe it to be a most sound book, he says, page 628, numerous indications of the phenomenon (*i.e.* of the upheaval of the circumpolar land of North America) have been recognised in the Arctic islands, scattered off the coasts of the Continent. At Port Kennedy Mr. Walker found shells of the present period at a height of 557 feet above the sea; a bone of a whale lay at a height of 164 feet. Again, page 651, after saying that Southern Greenland is being depressed, he continues, "On the north of Greenland, from lat. 76°, and in Grennell's land, &c., the directly contrary phenomenon is taking place." Hayes discovered on all the coasts the existence of ancient sea-beaches which had gradually risen to the height of 100 feet.

I have thus shown good ground for entertaining the notion that the land at present rising about the Pole is a continuous area, and is not rising merely in detached masses as M. Reclus's and Mr. Murray's maps (Geographical Distribution of Mammals) would lead us to suppose. I believe, further, that this area, bounded on the south by about the 57th parallel of latitude, *is the only area in the Northern Hemisphere which is at present undergoing upheaval*. I should feel grateful to any of your correspondents who would point out where there is another area (of course excepting local disturbance immediately round a volcanoe); or would direct me to any authorities throwing light on the question I have advanced, which for anything I know may be an old theory, or even an exploded heresy.

Not only is the land around the Pole rising, but there is evidence to show that the nearer we get to the Pole the more rapid the rise is. This has been shown most clearly in the case of Scandinavia by Sir Charles Lyell, who most carefully guaged the rise at different latitudes from Scania, where the land is almost stationary, to the northern parts of Norway, where the rise is four feet in a century. While in Spitzbergen and the Polar Sea of Siberia, if in the memory of seal fishers and others the water has shallowed so fast as to have excluded the right whale, we may presume that the rate of emergence continues to increase, until it reaches its focus at the Pole, as it certainly diminishes until it disappears towards the south between the 56th and 58th parallels of latitude. The subject is one of paramount importance to those who are trying to work out the history of the earth, and I once suggested at the British Association that it should be made the work of a special report, but I was snubbed. I appeal with more confidence to you, sir, to help me to ventilate it. The question of the *subsidence* of other areas, and of the correlated climatic change, I will reserve for another letter.

HENRY H. HOWORTH

Derby House, Eccles

THE ENGLISH GOVERNMENT ECLIPSE EXPEDITION

MANY of the readers of NATURE are no doubt interested in the fate of the Eclipse Expedition of 1871. I will therefore give a sketch of their doings to the present time.

The P. and O. steamer *Mirzapore*, having the party on board, left Southampton on Oct. 26, and, after a rather rough voyage, reached Malta on Nov. 4; left again the same evening, and arrived at Port Said on the 8th; entered the Canal at once, and anchored at Suez on the 10th. Here she remained till the 12th, awaiting the arrival of the Brindisi mails; then left for Galle, where she arrived the 27th. On leaving the Channel a strong S.W. breeze was encountered, which soon increased to half a gale. The ship, though a roller, is a good sea boat, and made good progress; but the bad weather continued with little abatement until the *Mirzapore* was well in the Mediterranean, and nearing Malta. The sea then became calmer, the sun shone out, and the passengers, many of

whom had not before emerged from their cabins, now came out as gay as possible, ready to make an impression at Malta. Our astronomers, who had not been exempt from the common fate of those who try the sea without a special education, now quickly roused themselves to make use of the opportunities for overhauling their instruments, and practising themselves for the work before them. The officers of the ship kindly gave every assistance, and those instruments that could be used on so unsteady a platform as a ship's deck were brought up from the hold, in which they had lain safely during the gale in the Bay, mounted on temporary stands, and used most diligently to investigate the changing phenomena with which we were surrounded. Classes also for mutual instruction were formed, so that each observer, on being detached in India, might —no matter what his special forte, whether spectroscope or polariscope—be able to impart instruction to the volunteers that we hope to obtain in India to aid in the good work. Our party numbered ten, viz.: Mr. Lockyer, chief, Messrs. Abbay, Moseley, Friswell, Capt. Tupman, R.M.A., and Commander Maclear, R.N., spectroscope observers; Dr. Thomson and Mr. Lewis, polarisers; Mr. Holliday, artist; and Mr. Davis, photographer. At Suez we were strengthened by the addition of Signor Respighi, from Rome, who has so distinguished himself by his observations of the solar atmosphere. The other passengers took great interest in the doings of the "Wise Men of the East," as they called us, and at their request, the day before arrival at Malta Mr. Lockyer gave a lecture on the advances that had been made of late years in solar physics, and on the object of this expedition.

Observations were made, as opportunities were given by clear sunrise and sunset at sea, on the alterations that take place in the absorption bands as the sun rises from the horizon; and here may be mentioned the interesting result, that whilst in the open sea the bands at sunrise and sunset were, with slight variations, the same as observed by Lieut. Hennesey (paper read before the Royal Society May 21, 1870) whilst passing through the Suez Canal and down the Red Sea, the lines attributed to aqueous vapour near C and D were weaker, and although the colour of the hills about Suez was of a delicate purple, especially at sunset, the violet end of the spectrum could hardly be seen.

In the Indian Ocean, when the air was close and filled with moisture, and the N.E. monsoon blowing, the absorption bands near the horizon became very strong, and it was very interesting during the afternoon to fix a telescope with spectroscope attached, so that the horizon bisected the field; the spectrum of the air above the horizon then gave the absorption bands, but they were very faint in the light reflected on the water from the upper part of the sky, and they could be seen lengthening and shortening as the ship rolled towards or from that side. On pointing the spectroscope at the sky above, only the ordinary solar spectrum could be seen.

The Canal was entered on the 8th of November about 3 P.M., and the ship anchored at Suez at noon on the 10th. The *Mirzapore* is one of the largest vessels that has passed through the Canal, and though she got through safely, it must not be supposed that she did not touch at all; in fact, the Canal is so narrow that too little room is left to allow for the time that so long a ship (400 feet) requires to answer her helm, especially at slow speed; and though the helm was shifted, and in some cases the engines reversed, as soon as the bow deviated from the straight line between the piles marking mid-channel, she could not be prevented touching several times. The narrowness also occasions delay when two vessels have to pass, one having to haul close in to the bank, and make herself as small as possible while the other goes by. But it is a grand work, and we have fully experienced the advantage of it, in avoiding the trans-shipment of our instruments, and the rough handling they would have experienced crossing the desert. We anchored in the Bitter Lakes on the evening of the 9th. The cause of the name they bear was shown by the fact, attested by our engineer, that the water was much salter than in the canal on either side.

On arrival at Galle we were delighted to find that Admiral Cockburn had brought his flag-ship the *Glasgow* to meet us, and convey our Indian party to Beypoor and Baikul. He has kindly placed all his accommodation at our disposal whilst he visits Ceylon. All our instruments were embarked yesterday, and we leave this morning for Beypoor, where we hope to arrive on the 2nd. The colonial steamer *Serendib* left yesterday with the parties for Jaffna and Trincomalee.

I can now give you the last dispositions of our party. In consequence of M. Janssen taking his station on the Neilgherries, we shall occupy two stations in Ceylon: Jaffna, where will be Captain Fyers, R.E., Captain Hogg, Captain Tupman, R.M.A., and Mr. Lewis; and Trincomalee, Mr. Moseley and Mr. Ferguson.

In India, Baikul or Ootacamund will be our head quarters, occupied by Messrs. Lockyer, Davis, Maclear, and Dr. Thomson; at Manantawhaddy, Messrs. Abbay and Friswell; at Poodacottah, Mr. Holliday and M. Respighi.

I hope I shall be able to tell you of the success of our efforts.

J. P. MACLEAR

Galle, Ceylon, Nov. 28

The following provisional arrangements have been made in order to save time after arrival at Galle. Observers are warned that they are liable to alteration on receipt of information from the Indian and Ceylon authorities:—

1. The expedition will be divided into six parties as follows: (1) Lockyer, Thomson, Maclear; (2) Respighi, Holliday; (3) Tupman, Lewis, Ferguson; (4) Abbay, Friswell; (5) Moseley; (6) Davis.

2. Each party will be under the charge of the observer just named in each party, who will be held responsible for the instruments, &c., detailed for the use of observers. He will also be the channel of communication with the local authorities, and will make arrangements for the observations to be made by local volunteers.

3. Special instructions will subsequently be issued for the observations, and stations will be named. Each observer will be responsible to the chief of the expedition alone for these observations.

4. The observers in charge of each party will hand in to the treasurer a receipt for the instruments, &c., detailed for each party.

5. The observer in charge of each party will make a list of the cases containing the instruments, &c., and will arrange for their transfer from the *Mirzapore*, and for their future transit.

6. He will be held responsible for the repacking of the instruments after the eclipse, and for their transmission to Galle or Bombay.

To this we are able to append the following official instructions:—

The Ceylon party to be as follows:—Captains Fyers, Hogg, and Tupman; Messrs. Moseley, Lewis, Ferguson, jun., and Fœnandez.

Observing Stations to be as follows:—1. Jaffna and station south; 2. A position as far north of Trincomalee as possible, and a station south.

Instruments to be detailed as follows:— recording Dublin spectroscope, Capt. Fyers; tube Dublin spectroscope, Mr. Ferguson; analysing spectroscope, Mr. Moseley; camera, Capt. Hogg; polariscope, Mr. Lewis.

Mr. Fœnandez should observe on the central line. He should instruct two observers to make drawings of the Corona on a plan similar to his own near the southern limit of totality.

The recording spectroscope to be used to determine coronal lines in the red end of the spectrum to, and in-

cluding, F. A high power should be used, and the prism should be adjusted for the minimum deviation of the central ray of this portion.

The tube spectroscope should be used in a similar manner for the other part, including F. Intensities referred to F to be most carefully noted.

Care to be taken that observers are not interrupted for two hours after totality.

Instruments to be returned to Galle, and shipped in P. and O. steamer, consigned to J. Browning, 111, Minories, London, E.C. All observations, photographic plates, drawings, &c., to be sent to Mr. Lockyer within a week of the eclipse. Observers to keep exact duplicates in case of loss.

The following resolutions were passed by the Government of India in the Home Department—under date 27th July and 21st October :—

"Colonel Tennant has already been authorised demi-officially to provide the astronomical instruments and photographic apparatus that he will require for his observations, and the Governor-General in Council understands that he is now in communication with Prof. Airy and Mr. Huggins on the subject. The cost of these appliances has been included in the estimate appended to Colonel Tennant's memorandum.

"In addition to these instruments, Colonel Tennant will require the aid of qualified observers, and it has been ascertained that the Superintendent of the Great Trigonometrical Survey is prepared to place the services of Mr. Hennessey and Captain Herschel, belonging to his department, temporarily at the disposal of Colonel Tennant for this purpose without prejudice to their proper duties. The Governor-General in Council approves of this arrangement, and is pleased to direct that the Survey officers above-named shall suffer no loss of their allowances while so employed, and that they shall have their travelling expenses paid out of the allotment of Rs. 15,000 sanctioned on account of the Eclipse observations. Colonel Tennant will arrange with Major Montgomerie beforehand when the officers in question should join them.

"The Governor-General in Council is further pleased to direct that Colonel Tennant shall receive from the Surveyor General's Department all the aid that he may require as regards photographic assistants, chemicals, &c.

"Lastly, the Governor General in Council is pleased to direct that the report of the result of Colonel Tennant's observations, and his accounts, shall be submitted by him to this department."

"From the correspondence received with the above despatch, the Governor General in Council has learnt that an expedition is being sent out from England under instructions from the Eclipse Committee of the British Association, and he is desirous that the Government of Madras will afford the expedition such assistance as it may require in the furtherance of its operations. Such assistance will probably consist in the provision, on a moderate scale, for three or four persons, at each place selected, of tents, means of subsistence, and locomotion, and in the erection of temporary observatories of a simple form. It may also be desirable to depute one or two persons to each party from the Public Works Department to assist the observers.

"Information has also been received that the French Government has deputed M. Janssen to visit India with the same object, and the Governor General in Council desires that the Government of Madras will afford every facility and assistance to that gentleman also.

"The Financial Department will be moved to sanction any reasonable expenditure that may be necessary to enable the Government of Madras to give effect to these instructions."

ARCTIC EXPLORATIONS

A SHORT paper of mine on the above subject appeared in NATURE of the 7th December, in which I stated some reasons for my belief that Smith Sound possesses no apparent advantages over Spitzbergen as a route by which to reach a very high northern latitude or the Pole itself. In fact I think the advantages are all the other way; and I shall endeavour to show one or two more reasons than I have already given for this belief.

Kane's and Hayes' ships were stopped by ice in Smith Sound before they reached lat. 79°, and this, I think, can readily be accounted for by the peculiar contour of the coast-line, as may be seen by the accompanying rough outline, taken from a copy of Dr. Hayes' chart in the Royal Geographical Society's Map-room.

The width of Kennedy Channel (a continuation of Smith Sound) is at 80° north lat. about 40 miles, but between latitudes 79° and 80°, Smith Sound expands to a width of something like 100 miles, this expansion being chiefly formed by a large bay on the east side. The south point of this bay, which I have marked A in the accompanying chart, runs far to the west in lat. 78° 30′ (thus changing the direction of the Sound from nearly true north and south to N.E. and S.W.), and approaching within 30 miles of the west shore at the point B.

If there is, as I believe, a set or drift of current southward, the ice will first be pressed with great force—as Kane found to his cost—against that side of the bay of which A is the south point, and then it will be driven across to the west shore somewhere near B at the narrowest part of the Sound in a closely-packed and continuous stream of heavy floes hitherto found impenetrable.

Should this idea be correct, and there is something more than theory to support it, this obstruction will be a constant and not an occasional one as long as there is a supply of ice to the north.

If there is a large opening extending far to the west at the place marked C, we have another probable opposing element; for if the set of current runs eastward through it, we shall have an important addition to the Smith Sound supply of ice, in making the barrier of the "*pack*" more formidable. The opinion I express as to the direction of the currents is not wholly hypothetical, for we have proofs of an *almost constant* current (it is sometimes reversed by strong winds) setting southward down Baffin's Bay and Davis Strait; and this current can only be fed by Lancaster and Smith Sounds and other openings to the west and north.

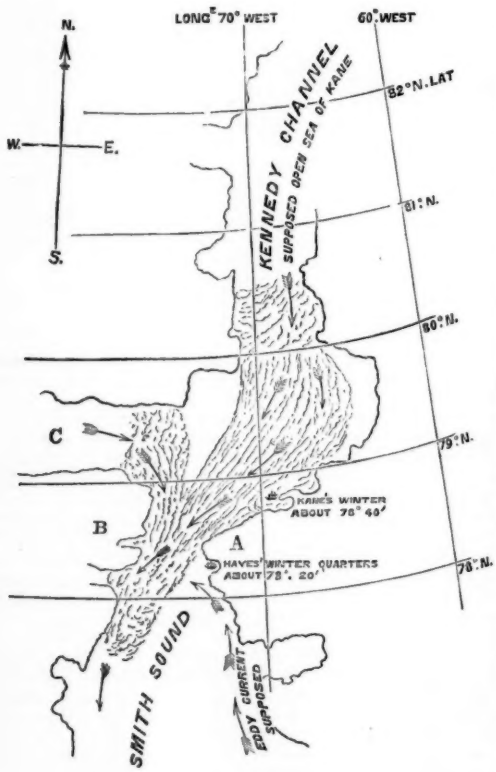
The only hope of an "easy" passage up Smith Sound to a higher latitude than 78° 40′ is the existence of Kane's "great open Polar Sea," for if such sea does exist, there would be no ice to the northward to keep up the supply of this commodity in Smith Sound, which would in the summer months be cleared of its winter covering by the southerly drift I have already mentioned, and the Sound would, and probably will be, consequently free from ice in August. But this is opposed to both Kane's and Hayes' experience, whatever their expressed opinions about the large open sea may have been.

That Kane's man Morton saw a very considerable extent of open water is not to be doubted, also that it may be quite true that he saw no ice to the northward, although he put down a point of land (whether correctly or not it is difficult to say) seventy miles distant in that direction. Every one, however, must be aware—for it is not necessary to have been in the Arctic seas to acquire such knowledge—that when the temperature of the air is lower than that of the water, a vapour or haze is formed by condensation, which, although by no means dense when looking through a small extent of it, becomes so much so when the observer has to look through eight or ten miles of it, that any low object, such as floe ice, would be quite in-

visible at either of these distances, and the haze itself would give the appearance of a distant water horizon.*

The opinion that this open sea was of limited extent is, I think, further confirmed by what Mr. Morton states as a proof (as he thought) of its being "boundless" or very large. Morton says "that he remained for three days watching the open sea rolling in waves at his feet, and, although there was a strong breeze or gale blowing from the north all the time, not a single piece of ice" floated past to the southward.†

My interpretation of the above fact is quite the opposite to that of Morton, for I believe there was a barrier of fixed ice at no great distance to the north, hid from his view by the cause I have named, which prevented any ice driving south at the season of the year when Morton was there, I think in June.



I offer these opinions with much diffidence, for we have been recently told that all great Arctic authorities now agree as to the Smith Sound route being the best. When the subject was brought prominently to notice in 1865, the "great authorities" did not agree, there being about as many opinions on one side as on the other.

At that time, without the slightest pretence to being an "authority" in the matter, I looked rather closely into the figures on which the facts favourable to the Smith Sound route were founded, and finding these figures in several important instances erroneous, the facts themselves lost much of their value. JOHN RAE

* I use the term "water horizon" in opposition to "ice horizon," which exhibits a bright line easily recognisable by those who have once seen it.

† As I quote from memory, I give to the best of my belief Morton's meaning, if not his words.

THE TYPHOON OF 2nd SEPTEMBER, 1871

THE Typhoon in China of the 2nd September last, detailed accounts of which reached England by the last mail, and which included in its area of most active violence the island and vicinity of Hong Kong, affords to those interested in such natural phenomena an opportunity of observing their varied characteristics, that may possibly never occur again. The great centre of its efforts having been in a situation where elaborate observations could be taken regarding it both at sea and land, a vast amount of information has been collected on the subject, which throws more light upon these singular "freaks of nature" than has ever before been arrived at.

In treating on the subject, I shall in the first place point out the course which—after careful investigation—I believe the typhoon to have followed, and afterwards I shall state the evidences that I adduce in support of the theory which I have adopted. Before commencing, however, it may be as well briefly to illustrate the plan engraved. The names *Formosa*, *Siam*, *Onward*, *Mikado*, *Woodbine*, and *Anna Henderson* are those of six vessels which were on their way to and within a short distance of Hong Kong during the typhoon, and extracts from whose shipping reports are now before me. A portion of the continent of China is to the north of the plan. The town of Macao and the islands of Hong Kong, Lantao, and Lema are in their respective positions.

The course which was taken by the typhoon was nearly allied to a parabolic curve. I have not attempted to trace its source farther eastward than the position indicated by 22° 30′ N. lat. and 116° 10′ E. long., where it overtook the *Formosa* (see *a* in map), or to follow it beyond the point indicated by 21° 15″ N. lat. and 115° 45′ E. long., where it struck the *Onward* (see *f* in map) on its return from the West. This portion of its course is marked in the plan by a succession of dotted lines. Consequently my observations are confined to the proceedings of the typhoon within these limits. After passing the *Formosa*, it swept over Hong Kong, crossed the mouth of the Canton River, and continued its headlong career to the town of Macao. Approaching this point, however, it was met by a strong northerly gale, and turned towards the south, but again encountering opposition in the shape of a south-west gale, it returned towards the east, upsetting the *Mikado* and driving the *Onward* before it. Throughout its entire course it consisted of a comparatively narrow belt of wind.

So much for the statement of my theorem. Now for its proofs.

I assume that only three conditions are necessary to substantiate my argument:—

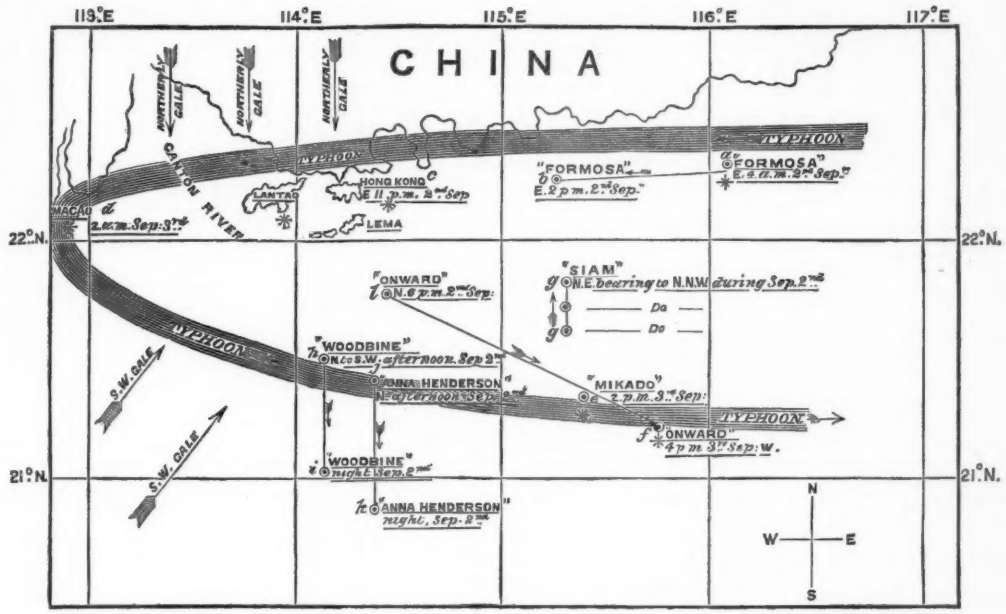
1. I must prove that the typhoon reached the various positions which I have indicated in the order actually laid down.

2. That it reached them at successive intervals of time.

3. That its greatest observed efforts were exerted on or in the vicinity of the line adopted by me, and not at any appreciable distance to the right or left of it.

4. That the two opposing gales, which I have described as occasioning the alteration in the course of the typhoon, did actually exist.

The first and second of these four conditions appear to be so intimately connected, that I think I cannot do better than consider them together. The earliest observations of the typhoon were made by the *Formosa*, which experienced its full force in the situation indicated in the plan between *a* and *b*. Both positions are accurately determined. The following is an extract from the shipping report: "On September 2, the barometer 29·30, experienced very heavy typhoon; during the typhoon the ship suffered some damage. At 4 A.M. on 2nd inst., barometer 29·25, blowing very heavy from east; at 12 noon, the same day, the wind moderated; at 2 P.M. on same made some



sail." The second series of observations was taken at Hong Kong (*c* in plan). Here I may quote from the register kept at Junk Island, near Hong Kong, during Saturday, September 2, and Sunday, September 3 :—

September 2

Hour	Wind	Force	Barometer
1	N.N.W.	6	29·58
2	,,	,,	29·54
3	,,	,,	29·52
4	,,	,,	29·50
5	,,	,,	29·48
6	,,	,,	29·46
7	,,	,,	29·45
8	,,	,,	29·44
9	N.N.E.	,,	29·42
10	,,	7	29·40
11	N. by W.	7	29·39
Noon	,,	8	29·38
1	,,	9	29·35
2	N.	9	29·30
3	,,	9	29·29
4	N. by E.	10	29·28
5	,,	10	29·27
6	N.N.E.	10	29·22
7	,,	10	29·19
8	N.E. by N.	11	29·16
9	E.N.E.	12	29·16 *
10	,,	12	29·15 *
11	E.	12	29·17 *
Midnight	E. by S. ½S.	12	29·18

September 3

1	E. by S. ½S.	12	29·18
2	E.S.E.	11	29·25
3	,,	10	29·30

—and so on, the barometer rising, as the gale decreased.

It will, of course, be remarked that the *east* wind was the veritable typhoon. This is clear from the fact of the barometer reaching its lowest point, and the force of wind being the highest registered, at or about the hour when the vane pointed to the east. Now, to proceed in the same direction that the typhoon is following as far as the town of Macao (*d* in plan). No register, unfortunately, was preserved—at least, that has transpired—of the direction of the winds at Macao during September 2 and 3, but the barometrical readings were as follows :—

Date	Hour	Reading
September 2 ...	12 Noon ...	29·705
,, ...	3 P.M. ...	29 605
,, ...	5 ,, ...	29·555
,, ...	6 ,, ...	29·485
,, ...	7 ,, ...	29 475
,, ...	8 ,, ...	29·425
,, ...	9 ,, ...	29·405
,, ...	10 ,, ...	29·285
,, ...	11 ,, ...	29·185
,, ...	11·30 ,, ...	29·135
,, ...	12 Midnight ...	29·035
September 3 ...	1 A.M. ...	28·785
,, ...	1·30 ,, ...	28·485
,, ...	2 ,, ...	28·385 *
,, ...	3·30 ,, ...	28 885
,, ...	4 ,, ...	29·035

Still, although no record has been preserved of the direction from which the wind came on this occasion, it is evident, from the nature of the injuries inflicted upon Macao, that it was the turning point or apex of: he typhoon. The effects bore a strong analogy to those of a cyclone or whirlwind, as will be seen from the following extract from the *Overland China Mail* of September 15 :

"No less than three vessels, the *Vistula*, French *Edouard et Marie*, and a Dutch barque, have been wrecked in the roads. . . . . Baron de Cercal's house on the point has been unroofed ; the clock tower top has been blown down ; and the façade of the San de Lorenzo Church has been torn off by the force of the wind." Continuing still farther round the course indicated by the

* At this time, between 9 and 11, the typhoon struck the island.

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dotted lines in the map, and omitting to take notice of the *Woodbine* and *Anna Henderson*, we arrive at the *Mikado*, whose situation (marked *e* on the plan), although not so clearly specified in the report as might be desirable, must, nevertheless, have approximated to that laid down, if we take into consideration the direction from which it was sailing (from Saigon to Hong Kong) and the time at which it arrived in harbour, viz., about four and twenty hours after the typhoon had passed over it. The shipping report is as follows:—"On midnight the 1st inst. (September) the barometer falling, wind increasing from the northerly, barometer falling rapidly. On midnight of the 2nd instant, the weather *indicating* a typhoon, began to take in sail; the wind continued increasing, the barometer still falling; at 8 A.M. on the (3rd)* instant took in the main topsail; at 11 A.M. till 2 P.M. blowing a very heavy typhoon, the ship lying on her beam end, the barometer 29·34. . . . . At 3 P.M. weather began to moderate, and the ship began to righten. . . . . At 8 P.M. on same day the weather again moderated, and we then commenced to make sail to Hong Kong; the wind *rounded* to E.S.E." (showing that it had been westerly or north-westerly during the gale). But the fullest and most minute account of the typhoon appears in the narrative of the *Onward's* adventures during its occurrence; and here, fortunately, I am able to repose the utmost confidence in the statements adduced, owing to a personal acquaintance of several years with the Captain and officers of that vessel. There is not the remotest difficulty in determining the position of Captain Whyte's vessel during the 2nd and 3rd September, the bearings and distances being quoted on all important occasions. The report runs thus:—"Current setting to S.W. ½ W., 34 miles daily. September 2, at 6 P.M. (barometer 29·83), N.E., head of Lema Islands, bore N. by W. ½ W., 15 miles distant; tacked ship and stood to eastward, wind at N. with a heavy easterly sea coming away, with all appearances of bad weather; midnight (barometer 29·70) wind N. increasing to a gale; reduced the ship to two topsails; 4 A.M. (barometer 29·59), wind still at N., gale still increasing with heavy sea from the eastward; 8 A.M. (barometer 29·39), strong and increasing gale, furled all sails, and secured them with double gaskets, and made every preparation for a hard gale. September 3, at noon (barometer 29·15, still falling), wind N.W., blowing most terrifically with a fearful cross sea, ship pitching heavily, putting bowspit and jibboom under water at times, and filling the decks with water; 4 P.M. (barometer 29·3), wind W., blowing harder than ever with thick rain; at 6 P.M. (barometer 29·10), wind W.S.W. blowing still most terrifically with a most fearful cross sea running; at 8 P.M. (barometer 29·20), wind S.W. inclined to moderate, sea still very heavy; midnight (barometer 29·39), wind at S., both wind and sea greatly down with all appearance of better weather; 6 A.M. (barometer 29·60), wind S.S.E., moderate breeze, made sail and squared away for port." The run of the ship from 6 P.M. September 2 till 4 P.M. September 3, I have represented by the line *l f*, as although the course taken was *supposed* to be easterly, the *strong current* setting in a S.W. direction would certainly bring it down to the point *f*. Thus the ship in endeavouring to escape the typhoon ran right into it! Now what may be gathered from all these facts? That a terrific gale from the east struck the *Formosa* in the position indicated by *a* on the 2nd September at 4 A.M.; that it passed over Hong Kong (at *c* in map) between 10 and 11 the following night; that it reached Macao (*d* in map) at 2 A.M. on the morning of the 3rd, exhibiting such peculiar phases of character as would lead one to believe that it was revolving on its axis; that (after changing its direction) it overtook the *Mikado* in the position indicated by *e*, at 2 P.M. on the 3rd September; and that finally it swept over the *Onward* in the position indicated by *f*, still coming from the west, at 4 P.M. the same day.

Hence I conceive that my *first two conditions* are proven.

The third is as easily disposed of. That the typhoon did not spread itself out to any great extent in a northerly direction is clear from the fact of Canton not having experienced its fury. There was a smart gale blowing on Saturday and Sunday; but the barometer did not descend below 29·40, and the typhoon was described there as being "insignificant." That it was not felt so far south as 21° N. lat. is evident from the shipping reports of the *Woodbine* and *Anna Henderson*, which make no mention of it. They speak of gales blowing hard from the N. and S.W., and culminating upon the *evening* of the 2nd of September; but it is apparent, from the tone of their descriptions, that they did not encounter the veritable typhoon. The *Woodbine's* report is as follows:—"2nd of September, about thirty miles from Lema Island, when encountered a heavy typhoon from N. to S.W., with heavy sea." The *Anna Henderson* says:—"Wind veering to N.; on the 2nd increased to a gale, splitting several sails; at 7 A.M. on same day blew away the main topsail, the gale continued up to 6 P.M., than began to moderate." Their courses after receiving the shock of the northerly gale are represented by *h i* and *j k*, and these cannot be far from the actual ones taken, as the positions *h* and *j* are determined from observations quoted in the shipping reports, and the ships having been small, with wind and current both dead against them, *must* have been *driven* in the directions indicated. Fortunate for them that it was so, for by this accident they escaped the typhoon altogether. With regard to the interior edge of the typhoon, it would be impossible to ascertain how far it extended; but that there was a region of comparative calm within its circumference is easily proved. The *Siam*, from Newchwang, a port in the north of China, when in 21° 30′ N. lat. and 115° 15′ E. long., experienced a gale, which, during the 2nd of September, went right round the compass, clearly showing that the ship was in the centre of the typhoon. But that the *Siam* did not feel the full force of the gale or anything like it is equally clear from the trifling notice taken of its effects. The date of this vessel's arrival in port leads us to believe that it scarcely altered its position during the gale; probably as the wind veered round it drifted northwards, as indicated at *g g* in the map. The shipping report states:—"1st of September, in lat. 21° 30′ N., long. 115° 15′ E., when experienced *another* heavy *typhoon** from N.E. veering to N.N.W., and round to S.S.E., with very heavy cross sea, and much rain; on the 3rd inst. it began to moderate, wind from S. to S.S.E." I think therefore we may fairly gather that the typhoon's influence did not extend in any great degree to the right or left of the course laid down for it in my map.

Hence condition *three* is proven.

The fourth condition scarcely requires demonstration. The truth of it is apparent from the report of the wind at Hong Kong up to 3 P.M. on the 2nd of September, and that of the ship *Woodbine*, which occupied the most westerly position of any of the vessels, from whose accounts I have gathered my information.

It seems therefore reasonable to assume that the typhoon of the 2nd of September did take the course indicated by me, which is nearly that of a parabolic curve. Should such be the case, it goes far to prove that these eccentric phenomena have not a circular form, as has hitherto been imagined.

One of the most interesting facts that has been elicited from these investigations is, however, the indication that a space of comparative calm does exist within the circuit

* I have altered this from 2nd to 3rd as the typhoon could not have been "indicated" after it had actually *occurred!* The figure 2 was evidently a misprint.

* This shows in how qualified a sense the word "typhoon" must be taken in reading the *Siam's* report.

of a typhoon, a theory which has always been advanced, but, so far as I know, has never hitherto been substantiated by any actual observations. The case of the *Siam* is a strong argument in favour of the truth of such a theory, for in point of fact it may be said to have scarcely felt the effects of the typhoon at all.

Should any of your readers be disposed to sift the various evidences which I have adduced, the papers are in my possession, and access can be had to them at any time.

FRANK ARMSTRONG

NOTES

WE have received full intelligence of the English Eclipse Expedition from Mr. Lockyer, under date Galle, November 29. At that date the expedition had been detailed into various parties for service at different stations in Ceylon and the mainland; the instructions to these several parties are reprinted in another column. Mr. Lockyer, Dr. Thomson, and Captain Maclear were to observe at Ootacamund, Mr. Davis being detached to photograph at Gunote; Messrs. Abbay and Friswell were to go to Manantawaddy, Signor Respighi and Mr. Holliday to Poodacottah; while Captains Tupman and Fyers and Messrs. Moseley and Lewis were to proceed to Trincomalee. The Indian and Cingalese authorities and the officers of the *Mirzapore* and *Glasgow* had exerted themselves to the utmost to assist the expedition, and the Ceylon party acknowledge great obligation to Captain Fyers, the Surveyor-General. In another column will be found an account of the voyage out.

WE hear with great satisfaction that Mr. Edgar Leopold Layard, C.M.Z.S., has received the appointment of H.B.M. Consul at Para. Mr. Layard has already done good service to science in Ceylon and South Africa, and will now have the pleasure of investigating the fauna and flora of a third and not less interesting region. Before leaving England we understand that Mr. Layard will publish a new and revised edition of his work on "The Birds of the Cape Colony," which is now nearly ready for the press.

WE are informed that Mr. Leighton is preparing for publication a conspectus of all the Lichens hitherto discovered throughout the world, with diagnoses, &c., and also a second edition of the Lichen Flora of Great Britain, Ireland, and the Channel Islands, which will combine an Introduction, Glossary, and Index, and which, it is hoped, will be ready for the press early in 1872. The Glossary, &c., will be printed separately, so as to enable possessors of the first edition to purchase separately.

MR. T. K. SALMON, of Guildford, is making preparations to start on a collecting expedition to the highlands of the Columbian republic. Mr. Salmon's head-quarters will be at Medellin, in the State of Antroquia, whence he will explore the Cordillera of Quindin, and upper valley of the Cauca. Mr. Edwin Gerrard, jun., of College Street, Camden Town, acts as his agent, and will be happy to receive subscriptions in aid of the expedition.

WE are glad to hear that the well-known naturalist, Mr. W. T. Blanford, of the Indian Geological Survey, is appointed a member of the British expedition for the survey of the boundary between Persia and Beloochistan. Commencing on the coast of Mekran the party will pass northward to Seistan and Herat. In Seistan they will enter a most interesting region, of which the geology and zoology are quite unknown. The river Helmund, and Lake of Seistan, in which it loses itself, will certainly present many features eminently worthy of scientific investigation, of which no one is more qualified to take advantage of than the ex-geologist of the Abyssinian Expedition.

THE recent death of Dr. Seemann, who for nine years has conducted the *Journal of Botany*, has caused a change of editorship. A new (2nd) series will be commenced in 1872, under the management of Dr. Trimen, of the British Museum, for the last two years a sub-editor, with Mr. Baker, of Kew, who will continue to be associated with Dr. Trimen in the conduct of the new series. We are also requested to state that unavoidable circumstances will delay for a few days the publication of the January number.

THE Edinburgh papers record the death of Mr. J. B. Davies, assistant-keeper of the natural history section of the Museum of Science and Art in that city. Mr. Davies was appointed to his position in the museum, while it was in its old place in the College, by Edward Forbes during the brief period that gifted naturalist occupied the Chair of Natural History; and in the discharge of his duties he was as much distinguished by the extent and accuracy of his knowledge as by his readiness to assist all students of his science, and by his courteous bearing. In addition to his appointment in the museum, Mr. Davies held the lectureship on zoology in the Royal High School, was assistant-secretary to the Royal Physical Society, and an Associate of the Botanical Society. He was the au hor of a little manual of practical natural history termed "The Naturalist's Guide."

THE following have been elected office-bearers of the Edinburgh Botanical Society for the ensuing year:—President, Prof. Wyville Thomson, LL.D.; Vice-Presidents, Dr. M'Bain, R.N., Prof. Dickson, Mr. Buchanan, Dr. T. A. G. Balfour; Secretary, Prof. Balfour; Foreign Secretary, Prof. Douglas Maclagan; Treasurer, Mr. P. N. Fraser; Auditor, Mr. Tod; Artist, Mr. Neil Stewart; Assist. Sec. and Curator, Mr. John Sadler.

IN connection with the Gilchrist Education Trust, arrangements have, we understand, been made for the delivery at the Lambeth Baths of a series of lectures, chiefly of a scientific character. The names of Prof. Huxley and Dr. Carpenter are mentioned among the probable lecturers.

MM. DELAUNAY and Ch. St. Claire-Deville have presented to the French Academy of Sciences some further interesting notes of the cold of November and the early part of December. M. Delaunay remarks that the cold advanced, as is usually the case, from north-east to south-west. The minimum temperatures were recorded at Gröningen, in Holland, on Dec. 7 ($-10°$ C. = 14° F.); at Brussels ($-12°{\cdot}6$ C. = $9°{\cdot}5$ F.) on the 8th; and at Paris ($-21°{\cdot}3 = -6°$ F.) on the 9th. This extremely low temperature appears to have been limited to a very small tract of country between Paris and Charleville. On the same day the temperature was above the freezing-point in Scotland as far north as Nairn, and in the greater part of England, falling only at Greenwich as low as $-2°{\cdot}3$ C. (=28° F.). The severity of the frost was considerably mitigated at Paris on the 10th and 11th; but on the latter date it was again as low as $-22°{\cdot}6$ C. ($=-8°{\cdot}5$ F.) at Haparanda, on the Gulf of Bothnia, $-15°$ C. (= 5° F.) at Stockholm, and $-14°{\cdot}1$ C. ($=6°{\cdot}5$ F.) at St. Petersburg.

SOME of our readers will recollect the controversy which took place in the "Proceedings of the Zoological Society" and the *Athenæum*, some six months ago, respecting a tortoise's skull in the British Museum, upon which Dr. Gray had established a new genus and species, *Scapia falconeri*. Mr. Theobald maintained that this skull (received by the British Museum from the executors of the late Dr. Falconer) had originally belonged to one of the two typical specimens of Mr. Blyth's *Testudo Phayrei*, in the Indian Museum, Calcutta, and that consequently *Scapia falconeri*, Gray = *Testudo phayrei*, Blyth. Dr. Blyth maintained the contrary. We understand that the director of the Indian Museum has recently claimed the skull in question, and that it is now on its way back to Calcutta, so that the authorities of the British Museum must have given up their view of the question.

At a recent meeting of the Manchester Literary and Philosophical Society, Mr. John Hopkinson, B.A., D.Sc., detailed some experiments on the subject of the rupture of iron wire by a blow, the results of which are—1. That if any physical cause increase the tenacity of wire, but increase the product of its elasticity and linear density in a more than duplicate ratio, it will render it more liable to break under a blow. 2. That the breaking of wire under a blow depends intimately on the length of the wire, its support, and the method of applying the blow. 3. That in cases such as surges on chains, &c., the effect depends more on the velocity than on the momentum or *vis viva* of the surge. 4. That it is very rash to generalise from observations on the breaking of structures by a blow in one case to others even nearly allied, without carefully considering all the details.

We learn from the *Lancet* that all the English universities have now accepted the draft scheme for a Conjoint Examination Board, as proposed by the College of Physicians and the College of Surgeons of England, and that it only now remains to submit the matter to the standing counsel of the two latter bodies for their opinion as to the practicability of carrying out the scheme without in any way violating the provisions of their respective charters. It is pretty well known that in the case of the Royal College of Physicians no difficulty at all is apprehended. It is probably so with the College of Surgeons, but of this we have never had positive assurance.

Attention has been called to the present disgraceful state of the fine mausoleum erected to the memory of Sir John Soane, in the cemetery of St. Giles-in-the-Fields, King's Cross. The tomb of the founder of the first art museum and architectural library in England is surely deserving of preservation. At present, however, its balustrades are broken, its marble capitals chipped, the inscription wilfully defaced, and the entrance filled with brick rubbish. We commend this state of things to all art students.

In the current number of *La Philosophie Positive*, Nov.—Dec., 1871, M. Littré calls attention to the reorganisation of public education in France. "If we are ever," he says, "to have a public system guided by a sound general method, we must begin tentatively and experimentally with private effort;" he then adds, "As for ourselves, it is intended among the writers in this review to compose six treatises, one for each of the fundamental sciences, mathematics, astronomy, physics, chemistry, biology and sociology. They should be so subordinated one to another that each science should form an introduction to the next above it in the scale; they should also be so far restricted to what is of essential importance that the entire course might be mastered in a time compatible with the necessities of life; and complete enough to raise the student to the main level of positive knowledge." There has been a good deal of discussion, especially in this country, about the scientific value of Comte's classification of the sciences. Perhaps a practical experiment like the above is the best criterion of the question, and the wonder is that it has not been applied before.

After unexpected delays, the new Coast-Survey exploring vessel, the *Hassler*, left Boston on December 4, bound for California *vid* the Straits of Magellan. The *personnel*, which is under the scientific direction of Prof. Agassiz, and the plans of this expedition, have already been given.

Harper's Weekly gives the following account of the labours of Prof. E. P. Cope, of Philadelphia, mainly in the valley of the Smoky Hill Fork of the Republican River in Kansas, where, under the protection of an escort of seventy-five infantry, commanded by Captain Butler, and detailed by order of General Pope, he spent seventeen days in the diligent prosecution of his labours. As is well known to American palæontologists, this region is one of the richest of the world in fossil remains of reptiles and fishes. Of these a large number of specimens were obtained by Prof. Cope, many of extraordinary magnitude, and some of them entirely new to science. More or less complete series were obtained of the bones of animals previously known only by a few fragments, thus supplying much better information as to their affinities and position in the system. Nearly the entire skeleton of a large fish, provided with teeth of immense power, was exhumed. This animal is to bear the name of *Portheus molossus*; and its remains occurred in such abundance as to demonstrate that it must have been a characteristic and very formidable inhabitant of the cretaceous seas. Another discovery was that of a reptilian form related to or intermediate between the tortoises and serpents. The ribs of this animal were long and attenuated; but instead of being united in the carapace, as in the tortoise, remained separate possibly united by membrane. If built at all on the chelonian pattern the expanse would have been at least twenty feet. This is to be called *Protostega gigas*. During his explorations in 1870 Prof. Marsh ascertained the existence of a species of pterodactyl, or flying lizard, in the cretaceous strata of the West, and additional specimens of the same or another species were found by Prof. Cope during the expedition just referred to. The most gigantic reptiles met with by him this year were species of *Liodon*, *Polycotylus*, and *Elasmosaurus*. Of these *Liodon* was found most abundantly, and one specimen will probably prove to be the largest of all known reptiles. *Elasmosaurus* had the most massive body, and must have presented an extraordinary appearance, in consequence of the great length of its neck.

We have already referred occasionally to investigations prosecuted during the past summer on the great lakes of North America, into the fauna and physical condition of the deeper waters; and we find in the last number of *Silliman's Journal* a more detailed account of that portion of the work carried on in Lake Superior upon the U.S. steamer *Search*, under the direction of Gen. Comstock, of the Lake Survey, as reported by Mr. Sydney J. Smith, the zoologist of the expedition. The deepest water met with was 169 fathoms, the bottom being there covered, as in all the deeper portions of the lake, with a uniform deposit of clay or clay mud; and not the slightest trace of saline matter was detected in the water in any part of the lake. The temperature, everywhere below thirty or forty fathoms, varied very little from 39° F, although in August it varied at the surface from 50° to 55°. The fauna at the bottom was found to correspond to these physical conditions. In the shallow waters the species vary down to thirty or forty fathoms, after which the deep-water fauna begins, and the species appear to be uniformly distributed. The list of species is meagre, and the deep-water region is characterised rather by the absence of many of the shore species than by the presence of any peculiar class. The same crustaceans and marine forms met with in 1870 in Lake Michigan were also found here abundantly, together with the same species of *Pisidium*; and some of the crustaceans have so far been undistinguishable from those found in Lake Wetter, in Sweden. The detailed account, of which that in the *Journal of Science* is an abstract, appears in the report of the Chief Engineer of the army to the Secretary of War just presented to Congress (Report of American Secretary of War, vol. ii. p. 1020).

M. Raoult states, in a paper read before the French Academy of Sciences, that cane sugar becomes transformed into grape sugar under the prolonged influence of light. Having dissolved 10 grammes of white sugar in 50 grammes of pure water, and boiled the solution for a few minutes, he placed equal portions in two white glass tubes, which were then hermetically closed. One was deposited in a dark place, while the other was exposed

to light. Five months afterwards the tubes were opened, and the contents of that which had been exposed to light gave the reaction of glucose.

A CORRESPONDENT of the *Madras Times* states that on the night of the 21st of October a remarkable meteor was seen at Trevandrum. It first became visible in the northern part of the sky, proceeding at a rapid rate and in a straight line, at an elevation of from 35° to 40°. It was visible for about four seconds.

A BRAHMIN astronomer at Surat has "predicted" that a terrible earthquake will be felt in some parts of the Bombay Presidency either in December or January next.

INDIAN papers state that during the first six months of this year as many as 183 tigers and cubs, 393 panthers and leopards, 203 bears, 281 wolves, and 188 hyenas, were destroyed in the Central Provinces at a cost to the Government of about 9,000 rupees (900*l.*). What a chance for any enterprising Zoological Museum!

WE do not look for zoological statistics in the annals of trading companies; but there is one report that does afford material, that of the Hudson's Bay Company. There we see year by year the varying number of fur-bearing animals, given in a kind of Registrar-General's return of deaths. This year we do not see the details, but we learn there has been a great dearth of martens. A more serious ethnological fact is the great losses by small-pox among the Indians of the Saskachewan district, being no less than 3,000. Throughout the Hudson's Bay district the Canadian Government is employed in regulating the Indians, but this no less forebodes their extinction; the more particularly as a railway is advancing to the Pacific, and steamers are to be placed on the Saskachewan river and Lake Manitoba. Martens that are not killed and Indians that die mean reduced dividends to the Hudson's Bay shareholders and traders.

ON the Chilian map is to be placed Augol, just made a city. It is situated in lat. 37° 42′ S., long. 72° 17′ W., about three miles south of the head waters of the river Verzaro, and twenty-eight miles from Nacimiento. It was founded Dec. 6, 1862, and is a fortified place on the river Pecoiquen.

AT Santiago, in Chile, a zoological garden is to be formed in the Quinta Normal, or Normal Garden.

FROM recent accounts in the *Panama Star and Herald*, it appears the Panama pearl fisheries are now carried on by negroes, whose villages remind the traveller of Western Africa. The value of the fishery is about 30,000*l.* a year, but signs of exhaustion are now showing themselves. This is greatly attributable to the use of diving machines. A gentleman who owns one of the islands, having regulated his fisheries in the Ceylon manner, found that after two years' repose he got a larger crop. It is therefore suggested to regulate the Panama fisheries by law.

COAL has been discovered at Neblinto in Chile. That country is already largely engaged in the shipment of coal.

MUSCAT is now to be divided on the maps into two states, Muscat and Sohar, a once famous name.

THE diamond capital of Adamanta, at the Cape, is likely to become a permanent town. Its present settled and floating population is 20,000.

THE collector of Tinnevelly, in Madras, reports that he has come to the conclusion, after his inspection of the Government Pearl Fisheries, that the oysters migrate every year when young.

THE miners of Copiapa in Chile have undertaken an exploration by subscription of the rich mineral resources of their Cordillera.

*NUMERIC RELATIONS OF THE VERTEBRATE SYSTEM**

THERE are five (not four only) complete neural rib arches to to the cranium of all vertebrate animals, to wit: (1) The condylar or sensitive belt with the condyle plates for side ribs, and the lower arch of the transversely bipartite occiput for its vault piece; (2) the petrosal or acoustic, containing the auditory nerves in its side beams (easily detected by removing the ear drum of Felines, &c.), and overarched by the interior belt of the occipital squama; (3) the parietal belt originally containing the true gustative of fixed tastes (sour, sweet, salt and bitter, the glosso-pharyngeal), in an incision; from which it is, however, soon crowded out by the internal carotid artery and the overlapping "acoustic rib blade." The next (4) is the optic or frontal, visibly succeeded, in fishes, by (5) the ethmoidal or olfactory vertebra. The rest of the cranium is formed by its "extremities" or prehensile appendages.

The same numeric law which pervades the entire vegetable kingdom reoccurs in the human fabric in a very marked manner.

The number of "radiating elements" in a coil or whorl, or of whorls in a cycle, or in cycles generally speaking, as in pine cones and flower buds, &c., are the following:—

1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, &c., progressing by the summation of the last two numbers.

The bands or parallel coils of flowers or scales in pine cones, sunflower discs, &c., embody these numbers successively, as they grow steeper and steeper, alternately on the right and left. The vertical bands, or columns, give the number of parts of the cycles involved.

The explanation heretofore given by me is this, that one element generates the other.

The elements are radial; they are bilateral rays, with a rift, so to speak, on the opposite side. It is there where, in a like manner as the seed-leaves of flowering plants produce prolific "ovules," new radial organs are developed from the preceding ones—laterally at alternate heights and towards the wider spaces.

This process, referred to the radial organs of plants in an early stage, will yield:—

1. The numbers of parts in question, successively.

2. The peculiar law of interpolations or of "divergence," viz.: by a number of interstices represented by the second preceding one of each cyclar number.

3. It will conclude the cycles, if it be supposed that the activity of each junior member depends on that of its progenital one; as in all cases of simple branch developments.

These numbers occur in like manner in the human frame, as follows:

Inclusive of the terminal (ossified or gristly) coccygeal element, we have exactly thirty-four spinal vertebræ.

Classifying nerves by their work, or "function," we find—

3 pairs of cervical nerves (neck).
5 pairs of brachial nerves (arms).
8 pairs of pedal nerves, composed of 3 crural (lumbar) and 5 ischiadic (sacral) ones.
13 pairs of nerves to the rump.
5 specific ones of the cranium.

—

34 in all; whereas the number of the spinal vertebræ, which inclose the spinal cord is exactly 21.

There are five pairs of "extremities," organised after a common plan: (1) the lower, (2) the upper, (3) the temporal (bearing the lower jaw for a "member"), (4) the palate-facial, with the upper jaw for its "member," (5) the opercular or hyo-tympanic one, forming the gill-lid in fishes or the tympanic ossicles in man; and the digital extremity of which is gradually converted into the (hand-like) crimped (external and internal) cartilages of the ear.

The five pair of hæmal arches of the cranium, *i.e.* the gill arches of fishes, are gradually transformed into the gristles of the gullet, &c.

The main variation consists in the varying, but "cyclar" number of "rays," fingers, &c.; the varying cyclar number of their joints (1, 2, 5, 8, 13 respectively in a dolphin, with five carpels instead of eight, as in a man) and the varying cyclar number of "loose" ossicles, such as *carpals*, *tarsals*, *teeth*, &c. The number of spinal vertebræ is also variable, but not that of the cranial ones.

* Abstract of a Paper read at the Indianopolis Meeting of the American Association for the Advancement of Science, by Dr. T. C. Hilgard. Reprinted from the *American Naturalist*.

The vertebral blocks, as well as the ribs, are the product of the primitive axial series of (invertebral) discs, which, when completely arrayed, each bear five branches, viz., two pair of hæmal arches, two pair of neural arches, and a fascicle of parallel cleets, so to speak, which being cemented together, both in the front and rear, by the superficial ossification of the discs at either end, are fused into the block pieces, as found, *e.g.* in the young hog; the cementing slab covering the big neural rib head likewise, and not only the pentagonal prismatic block. The first disciform ossification we find in the corals, forming cribrose ethmoidal discs, such as the closely set "sigillate impressions" of the Astræa, and afterwards left behind as the coccyx, *e.g.*, of Byathophyllum.

*SIEMENS' DYNAMO-ELECTRIC LIGHT**

A SERIES of experiments was made last week at Sheerness, with a view of ascertaining the applicability of Siemens' dynamo-electric light to torpedo services in time of war. This scientific combination is produced, as its name signifies, by the application of excessively rapid motion generated from the fly-wheel of a steam-engine to a very powerful set of ordinary galvanic "coils" in connection with soft-iron magnets. The leather strap from a four-horse power engine, encircling a small gun-metal pinion, causes it to revolve with the extreme velocity of 1,600 revolutions per minute, inducing motion in an electric "bobbin" at the side of an apparatus consisting of several sets of strong insulated coils. A stream of electricity consequently passes through them. This stream is conducted to a second series of coils, larger and more powerful than the first, which are also in combination with a pinion revolving 800 times per minute, thus intensifying the stream as it passes through them to a very considerable degree. Both negative and positive currents are now alternately given off from another "bobbin" at the side of the second series of magnetic coils, to the train of insulated wires, which conveys them to the position from which the dynamo-electric light is to be exhibited. Here there is a delicately contrived apparatus for containing the carbon points, between which the light is to be generated, adjusted at the top of a tripod somewhat similar in construction to that of a surveying instrument. At the back of the two carbon points, and "slotted" vertically to admit of their holders passing through it, is a concave reflector of white polished metal, which collects the rays of light into a focus, and transmits them in any required direction by means of an adjusting hand wheel below. A minute aperture in the centre of the reflector, precisely behind the junction of the two carbon points, throws a representation of the flame upon a piece of opal glass in a frame fixed at the back of the reflector; and through the agency of another small hand wheel which causes the carbon points to approach or recede from each other, the flame can be reduced or intensified at pleasure, by simply turning the wheel, care being taken at the same time to keep a watchful eye upon the picture produced, as the withdrawing of the points to too great a distance from each other will extinguish the light. It should have been remarked before that ample means are taken by lubricating the electrical apparatus to counteract the evil effects which might otherwise arise from the excessive friction consequent on the rapidity of motion in the several parts.

The object of instituting the series of experiments which were made on Monday was to ascertain if it was possible to throw such a stream of light upon an enemy's working parties engaged in interrupting communications with a line of torpedoes at night, as would render them sufficiently conspicuous to be fired at and consequently driven off. The place selected was the new fort at Garrison Point, Sheerness. The engine and "coils" were erected in the enclosure of the fort, while the instrument itself was placed in one of the massive embrasures piercing its sides. No sooner was steam got up and the order given to turn ahead, than the burring noise of the machine indicated that electricity was being rapidly generated, sparks and stars of vivid blue light being given off at the various joints. Another instant, and a vivid stream of light shot across the sea to a number of ships lying in the offing at a distance of about two miles, lighting them up with the brilliancy and distinctness of broad moonlight. The effect was magnificent. Clouds of mists, rendered visible by the intensity of the rays shooting through them, rolled across the broad field of bright light from time to time, not, however, interrupting the view in their progress. By shifting the direction of the rays laterally, each object in turn came within the compass of the portion of horizon rendered clear. In fact, it was sufficiently apparent that no objects of any appreciable size, such for instance as an enemy's boats, could come within a mile or more of one of Siemen's dynamo-electric instruments in operation without being rendered conspicuous to any battery in the vicinity, and consequently involving to themselves the most imminent danger. Hence the result of the experiments may be pronounced a success; whether, however, a corresponding effect might not be obtained by a succession of parachute lights thrown from a rocket or mortar is quite an open question.

* Reprinted from the *Times*.

PHYSICS

Note on the Spectrum of the Aurora

ON the evening of November 19 there appeared one of the most magnificent crimson auroras ever seen at this place. When first observed, at about a quarter before six P.M., it consisted of a brilliant streamer shooting up from the north-western horizon; this was continued in a brilliant red, but rather nebulous mass of light, passing upward and to the north. Its highest points were from 30° to 40° in altitude. A white aurora, consisting of bright streamers, appeared simultaneously, and extended round to the north-east.*

The crimson aurora was examined with the spectroscope at six o'clock. The instrument used was a single glass-prism spectroscope, made by Duboscq, of Paris. On directing the slit toward the brilliant streamer above mentioned, a bright spectrum was observed consisting of five well-marked lines. A millimetre scale attached to the instrument was then illuminated with a gas flame, the auroral lines being readily measured, even when the numbers on the scale were bright enough to be read distinctly. The sodium line was used to adjust the scale, being equally divided by the division 100; the width of the slit was about one millimetre. As thus arranged, the five auroral lines, beginning at the red end, had the following positions:—Scale-Nos. 90, 110·5, 130, 138, 149. The brightness of the lines was, following the above order, 3, 1, 5, 2, 4, the second line from the red end of the spectrum being the brightest. The line marked 90 and the one marked 110·5 were sharp and well defined; the others were all nebulous on the edges. Before the measurements were completely verified by a second comparison, the crimson aurora entirely vanished, having endured less than half an hour. In the white aurora which remained, the spectroscope showed four of the five lines given; the crimson line alone was absent. The measurements are exact to half a division of the scale.

To determine the approximate wave-lengths of these lines, comparison was made both with certain metallic lines and with the lines of the solar spectrum. On the scale of this instrument the metallic lines employed read as follows:—

Kα 63, Liα 79, Srβ 80, H(*c*) 82, Caα 91, Srα 96, Caβ 113, H(*f*) 146·5, Srδ 163, Csδ 165, Csα 167, Rbα, & β 200, Kβ 218.

The Fraunhofer lines measured as follows:—

a 70·5, B 76, C 82, D 100, E 124·5, *b* 130, F 146·5, G 189.

Direct interpolation was used in comparing the wave-lengths of the auroral lines with those given above, the wave-lengths of the Fraunhofer and elemental lines being taken from Gibbs's tables (Amer. Jour. of Science and Arts, II. xliii. 1; xlvii. 194). This method was believed capable of giving results as close as the instrumental measurements. In this way the wave-lengths of the five auroral lines were obtained, as given in the following table:

Line.	Scale number.	Wave-length.	Auroral lines.	Other measurements.
B	76	687		
C	82	656		
(1)	90	623	623	627 Zöllner.
D	100	589		
(2)	110·5	562	562	557 Angström.
E	124·5	527		
(3)	130	517	517	520 Winlock.
b	130	517		
(4)	138	502	502	
F	146·5	486		
(5)	149	482	482	485 Alvan Clark, Jr.
G	189	431		

* Professor Newton informs me that he observed an equally brilliant red patch of auroral light in the north-east, five or ten minutes earlier. Since the lower end of the red streamers was much lower than that of the white, it would seem as if the red were seen through the white, the red being most remote.

In this table, column 1 gives the auroral and the Fraunhofer lines; column 2, the number of these as measured upon the scale of the spectroscope used; column 3, the wave-lengths of these lines obtained as above stated; column 4, the wave-lengths of the auroral lines, given by themselves; and column 5, the wave-lengths of what I assume to be the same lines, with their wave-lengths as measured by the observers mentioned.

The point of particular interest in this observation is the fact that the line (4) of wave-length 502 is not laid down in any authority accessible to me as having been observed in the auroral spectrum. Indeed, no previous observer, so far as I know, has seen any auroral line between the Fraunhofer lines *b* and F. Professor C. A. Young (*Journal of Science and Art*, III. ii. 332, Nov., 1871) gives two lines—Nos. 56 and 57, or 1866·8 and 1870·3 of Kirchhoff—observed by him in the sun's chromosphere and also by Rayet in the eclipse of 1868, one of which may coincide with this fourth auroral line.

New Haven, Nov. 13 GEORGE F. BARKER

SCIENTIFIC SERIALS

THE *Geological Magazine*, Nos. 86—89, August to November 1871. This valuable magazine continues to furnish us every month with important and interesting articles upon subjects belonging to the various departments of geology. In the first number now before us we find an interesting paper on volcanoes by the editor, Mr. H. Woodward, and a particularly valuable article by Mr. J. W. Judd on the anomalous mode of growth of certain fossil oysters. In the latter, which is illustrated with a plate, the author notices those oysters from various secondary deposits, in which the shell has acquired throughout the peculiar sculpture of some ammonite, *Trigonia*, or other shell, to which its lower valve has adhered during growth.—In the September number the most interesting paper is Mr. Woodward's description of a new Arachnide from the Dudley coal-measures. This animal, to which the author gives the name of *Eophrynus Prestvicii*, is most nearly allied to the existing genus *Phrynus*, and the specimen is remarkable for the beautiful preservation of the casts of both surfaces.—Among the contents of the October number we must call particular attention to Dr. Murie's article on *Sivatherium*, in which the author discusses the characters of that most remarkable animal, which he regards as most nearly allied to the Saiga antelope, the latter being placed by him at the central point of ramification of the hollow-horned ruminants, and leading from the ruminants towards the Pachyderms through the Tapir. This valuable memoir is illustrated with two plates, one representing the skeleton of the animal, the other giving an ideal restoration of the living aspect of the male, female, and young of this gigantic ruminant.—The November number opens with a biographical notice (with a portrait) of Sir Roderick Murchison, followed by a shorter one of Mr. Charles Babbage. The other articles contained in it are on relics of the Carboniferous and other old land-surfaces, by Mr. Woodward; on the prospects of coal south of the Mendips, by Messrs. Bristow and H. B. Woodward; on the futile search for coal near Northampton, by Mr. S. Sharp; and on the Foraminifera of the Cretaceous rocks, by Messrs. T. Rupert Jones and W. K. Parker.

THE *Journal of Botany* for November commences with an interesting contribution to historical botany; in a paper read by the late Robert Brown before the Edinburgh Natural History Society in 1792 on "The Botanical History of Angus" never before printed. It was probably his first contribution to botanical science, having been written when he was about eighteen years old. Prof. Thiselton-Dyer contributes some observations on "Fungi parasitic upon *Vaccinium Vitis-Idæa*," and Mr. A. W. Bennett "Further observations on Protandry and Protogyny," in continuation of his previous researches on this subject. Mr. T. A. Briggs has a note on an undescribed species of *Rubus*, and the remainder of the number is filled up with short notes, abstracts, extracts, and reviews.

The number for December opens with the commencement of a paper by Mr. J. G. Baker "On the Botany of the Lizard Peninsula." Although this district is well known to botanists as the habitat of many very rare and local plants, yet no detailed account has yet been published of the flora of this portion of Cornwall. From the idea that many plants very common in other parts of England would find their limit short of this south-western extremity of the island, a list is here given of every flowering plant observed during a three days' visit, accompanied by general remarks on the peculiarities of the flora, both in what it includes and in what is absent from it. The only other original paper of importance in the number is a new arrangement by the Rev. J. C. Leefe of the English species of the extremely difficult genus *Salix*.

Journal of the Royal Geological Society of Ireland. Part 1, vol. iii. new series (vol. xiii.), has just been published. It contains besides the Report of Council for 1870-71, J. Emerson Reynolds on two remarkable Crystals of Galena; G. H. Kinahan, additional notes on Foliation, and supplementary notes on some of the Drift in Ireland; R. G. Symes, on the Geology and extinct Volcanoes of Clermont, Auvergne—plates i. ii. iii.; W. H. Baily, on the genus *Pleurorhynchus*, and a new species—plate iv.; M. H. Ormsby, Analyses of some Granite Rocks from India, and of their constituent minerals (1668); Edwd. T. Hardman, Analysis of Trachyte Porphyry from Tardree near Antrim, and on the Analysis of a Limestone compared with that of the same rock where it is in close proximity to a Doloritic Dyke; R. C. Tichborne, note on the Geological Formation of some of the Tiroxides.

Journal of the Chemical Society, October.—This number does not contain any papers originally communicated to the Society. The abstracts of foreign papers, however, occupy nearly 100 pages, and comprise many subjects of interest. The importance of the work done this way by the Chemical Society can scarcely be estimated; the journal must now be of great value not only to the chemist, but also to the physicist, physiologist, and to the chemical manufacturer, for many papers in these subjects are abstracted fully. An abstract of M. Berthelot's paper on the heat evolved in the formation of organic derivatives of nitric acid is very interesting. It is shown that in the formation of nitroglycerine, a very small amount of heat is evolved, as compared with that evolved in the formation of gun-cotton or nitrobenzine. This will account for the ready decomposition of the former, and the formidable effects produced by its decomposition. Amagat has experimented on the compressibility and dilatation of sulphurous and carbonic anhydrides; he finds that they first begin to act as perfect gases at a temperature of 250° C. Several of the abstracts contained in this number have already been noticed in these pages. One of them deserves especial notice, by Friedel and Ladenburg, on silicopropionic acid; this body is the first in which the group CO_2H contained in organic acids has been replaced by the corresponding group SiO_2H. Amato has obtained a curious compound, glucosophosphoric acid, the sodium salt of which has the composition $C_6H_{11}O_5Na_2PO_4$. Waage has published a paper on the use of bromine in chemical analysis, in which he points out that this reagent can be substituted with advantage for chlorine in many instances; it is very useful in decomposing pyrites, the whole of the sulphur being easily oxidised. We find an abstract of Bischof's paper on Fire Clays, which appears to deal very practically with this most important subject.

THE part just issued of the *Transactions of the Linnean Society*, completing vol. xxvii., contains three papers, of two of these, "Revision of the Genus *Cassia*," by Mr. G. Bentham, the president, and "Contributions to the Natural History of the *Passifloreæ*," by Dr. M. T. Masters, abstracts have already appeared in our columns. The remaining paper, "Notes on the Reptiles, Amphibia, Fishes, Mollusca, and Cretacea, obtained during the Voyage of H.M.S. *Nassau* in the years 1866-69," by Dr. Cunningham, contains descriptions of several new species collected and named by the naturalist to the expedition, and notes on the habits, localities, and characters of many other species. All these papers are illustrated by plates.

The first part of Volume xxviii. is also published, consisting of only a single paper, Dr. Triana's monograph of the *Melastomaceæ*. After some general remarks on the order, and on each of the genera comprised within it in French, follows an enumeration of the species, with the synonymy, references to type specimens in the principal herbaria, and fresh descriptions of new or badly-described species. It is illustrated by seven plates.

THE *Bulletin of the Royal Academy of Sciences of Belgium* for September and October, 1871 (Tom. xxxii., Nos. 9 and 10), contains but little scientific matter.—M. J. C. Houzeau communicates a description of a method of measuring directly the

distance of the centres of the Sun and of Venus during the transits of that planet.—M. P. J. Van Beneden describes a new Sirenian from the Rupelian stage. The remains of this animal were obtained at Elsloo, near Maestricht, and consist of a portion of the cranium, one dorsal vertebra, and a series of seven caudal vertebræ. These are described and figured by M. Van Beneden under the name of *Crassitherium robustum;* he regards it as more nearly allied to the *Stelleræ* than to the Manatees and Dugongs. M. Van Beneden also notices the occurrence at Basel near Rupelmonde of a nearly complete skeleton of a Sirenian in brick-clay, and remarks upon the constant association of remains of *Squalodon* with those of Sirenians wherever the latter have been found in Europe. He also notices some points in the osteology of living Sirenia.—M. E. Van Beneden gives us a note on the preservation of the lower animals, in which he recommends the employment of solutions of osmic acid and picric acid for the preservation of the more delicate forms of animal life, such as the Medusæ, Ctenophora, &c. According to him these processes are most successful.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, December 21.—"Contributions to the History of Orcin.—No II. Chlorine and Bromine-substitution Compounds of the Orcins." By John Stenhouse, F.R.S.

"Note on Fucusol." By John Stenhouse, F.R.S.

Mathematical Society, December 14.—Dr. Spottiswoode, president, F.R.S., in the chair. Mr. K. Freeman, of St. John's College, Cambridge, was elected an ordinary member, and the following gentlemen foreign members of the Society:—Dr. Clebsch, M. Hermite, Prof. Cremona, Dr. Hesse, and Prof. Betti. Dr. Sylvester explained the methods he had employed in his paper, "On the theorem that an arithmetical progression which contains more than one contains an infinite number of prime numbers." The communication was limited to the case of arithmetical progressions proceeding according to the common difference, 4 or 6. The method employed appears to differ fundamentally from Dirichlet's method (Berlin Transactions, 1837). [In the account of Dr. Sylvester's previous communication to the Mathematical Society, given in NATURE, Nov. 23, p. 75, at line 18 from the commencement of the paragraph, for *intention* read *induction*, and at line 20 from the foot of the page, for the words *the magnitude* read *the order of the magnitude.*] Profs. Cayley and H. J. S. Smith took part in a discussion on the subject.—Prof. Clifford next spoke with reference to a paper he is preparing for the society.—Prof. Cayley then drew attention to the question of the determination of the surfaces capable of division into infinitesimal squares by means of their curves of curvature. It was shown by M. Bertrand that in a triple system of orthotomic isothermal surfaces each surface possesses the property in question, of divisibility into squares by means of its curves of curvature. But in such a triple system each surface of the system is necessarily a quadric. There is nothing to show that the property is confined to quadric surfaces, and the question of the determination of the surfaces possessing the property appears to be one of considerable difficulty, and which has not hitherto been examined.—Mr. S. Roberts exhibited a thread model of a homographic transformation of the developable surface which circumscribes a system of compound quadrics. The surface is generated by planes touching an ellipse at a constant inclination, and its equation is obtained by writing $p^2 z^2$ for r^2 in $\phi(x^2, y^2, r^2) = 0$ representing the plane parallel of an ellipse.

Anthropological Institute, December 18.—Dr. Charnock, president, in the chair. Lord Dunraven, Dr. John Best, and Mr. J. Kempe were elected members. A paper was read by Mr. Joseph Kaines on the "Anthropology of Auguste Comte." The sources of the paper were to be found in chapters on "Biology" and "Fetishism" of M. Comte's *Philosophie Positive* and in the *Politique Positive.* The paper itself aimed to show that the differences between man and the rest of the animal kingdom were not so great as they were usually represented, nor in fact were they so numerous in their resemblances. Treating man as the head of the zoological series, it argued that his dominion over animals was from primitive times (and is now) a moral dominion rather than intellectual, and it concluded, that in so far as external nature was used by man for moral ends, it was rightly used, and that the intellect found its true work in directing his affective nature to moral purposes and relationships.

Linnean Society, December 21.—Mr. G. Bentham, F.R.S., president, in the chair. "On the Anatomy of the American King-Crab (*Limulus polyphemus*, Latr.)," by Prof. Owen, F.R.S. The author, referring to anatomies of existing species of animals elucidating the type of structure of large extinct groups—as that of *Apteryx* in reference to the *Dinornithidæ;* of *Protopterus* in relation to the notochordal, protocercal Cycloganoids of palæozoic beds; of *Nautilus* as the representative of the constructors of extinct chambered and siphonated shells; of *Orbicula*, *Discina*, and *Terebratula* in like relation to extinct *Brachiopoda*—stated that, in reference to the Trilobite Crustacea, he had once doubted whether *Serolis* or *Limulus* would reflect most light on the internal structure of those ancient forms of the class. But, in the 14th lecture of the Hunterian Course of 1843, published in April of that year, appreciating the importance of the character by which the Xiphosures and Trilobites agreed in differing from *Malacostraca*, viz., in the numerical formula of segments, he decided to take *Limulus* in hand. Isopodal tendencies in Trilobites indicated, however, their more generalised character, and continued palæontological research led to the postponement of the original purpose, until the subsequent discoveries of a palæozoic group of Crustacea, due mainly to the labours of Salter, Huxley, and Woodward, decided the author no longer to delay the present communication, in view of its more special bearings upon the *Merostomata* of the last-named carcinologist. Of the external characters of *Limulus* but little was left to describe. The author accepted the evidence of the homologies of the three divisions of the body adduced by Dana, Spence Bate, and Woodward as outweighing that which influences V. der Hoeven. The "cephalothorax" of the latter author was the "cephalon," the second division was, not the "abdomen," but the "thorax," of the later carcinologists. The determination by the latter of the articulated appendages of the foremost division of the body of *Limulus* was also adopted. But as that division includes not only the brain, organs of sense, mouth, and manducatory instruments, but also the stomach, liver, major part of the heart, and genital organs, together with a long tract of the ventral ganglionic neural chords or centres, the author proposed to speak of it as the "cephaletron," the succeeding division as the "thoracetron," for the spine-shaped part he adopted Spence Bate's term of "pleon." In the description of the cephaletron, its modifications enabling it to act effectively as a burrowing digger or spade were dwelt upon, and the modifications of the hind border which articulates with the thoracetron were pointed out, showing that whilst by coalescence it was part of the foremost division in all its formal characters, more especially its upper pair of entapophysial pits and under pair of coalesced lamelliform appendages, it belonged to the series of lamelligerous segments constituting the thoracetron. The author then proceeded to give a detailed account of the muscular system of *Limulus*, and concluded this third section of the paper, by condensing notes made by Mr. Lloyd, of the Crystal Palace Aquarium, on the movements of living *Limuli* in captivity, and those made by Mr. Lockyer in New Jersey on the *Limulus polyphemus* in its native seas. The reading of this memoir will be continued at a subsequent meeting of the Linnean Society.

MANCHESTER

Literary and Philosophical Society, November 28.—Dr. J. P. Joule, F.R.S., vice-president, in the chair. "Encke's Comet and the Supposed Resisting Medium," by Professor W. Stanley Jevons. The observed regular diminution of period of Encke's comet is still, I believe, an unexplained phenomenon for which it is necessary to invent a special hypothesis, a *Deus ex machina*, in the shape of an imaginary resisting medium. I cannot be sure that the suggestion I am about to make has not already been made, but I have never happened to meet with it; and therefore I venture to point out how it seems likely that the retardation of the comet may be reconciled with known physical laws. It is asserted by Mr. R. A. Proctor, Prof. Osborne Reynolds, and possibly others, that comets owe many of their peculiar phenomena to electric action. I need not enter upon any conjectures as to the exact nature of the electric disturbance, and I do not adopt any one theory of cometary constitution more than another. I merely point out that if the approach of a comet to the sun causes the development of electricity arising from the comet's motion, a certain resistance is at once accounted for.

Wherever there is an electric current, some heat will be produced and sooner or later radiated into space, so that the comet in each revolution will lose a small portion of its total energy. In the experiments of Arago, Joule, and Foucault, the conversion of mechanical energy into heat by the motion of a metallic body in the neighbourhood of a magnet was made perfectly manifest. If then there is any magnetic relation whatever between the sun and the comet, the latter will certainly experience resistance. The question is thus resolved into one concerning the probability that a comet would experience electric disturbance in approaching the sun. On this point we have the evidence now existing that there is a close magnetic relation between the sun and planets. If, as is generally believed, the sun-spot periods depend on the motion of the planets, a small fraction of the planetary energy must be expended. I find, indeed, that a very brief remark to this effect was given in the memoir of the original discoverers of the relation, namely, Messrs. Warren De La Rue, Balfour Stewart, and B. Loewy. At p. 45 of their Researches on Solar Physics they add a small note to the following effect: "It is, however, a possible inquiry whether these phenomena do not imply a certain loss of motion in the influencing planets." As I conceive, no doubt can exist that periodic disturbances depending upon the motions of bodies must cause a certain dissipation of their energy; for if stationary the constant radiation of the sun could not produce any periodic changes, unless the sun were itself variable. Is there not then a reasonable probability that the light of the aurora represents an almost infinitesimal fraction of the earth's energy, and that in like manner the light of Encke's comet represents a far larger fraction of its energy? It is also worthy of notice that the tail of a comet is usually developed most largely at those parts of its orbit where the rate of approach or recess is most rapid, and where the electric disturbance would be correspondingly intense. I do not, of course, deny that the resisting medium may nevertheless exist, or may by other observations or experiments be made manifest. But I hold that so long as other physical causes can be pointed out which might produce the same effect, it is quite unphilosophical to resort to a special hypothesis. Encke's comet ought not to be quoted as evidence of the existence of such a medium until electric disturbance is shown by calculation to be insufficient to account for the observed diminution of period.

Liverpool

Geological Society, November 14.—Dr. Ricketts, president, in the chair. Mr. T. Mellard Reade, C.E., on the "Geology and Physics of the Post-Glacial Period, as shown in the Deposits and Organic Remains in Lancashire and Cheshire." The paper was largely illustrated by maps and sections. The author's views are summarised in the following conclusions:—1. That since the glacial period there are distinct evidences in Lancashire and Cheshire of three periods of depression or downward movement, and two periods of elevation or upward movement. There may also have been a period of elevation and a land surface previous to any of these movements, but posterior to the true glacial times. 2. That the first period of depression, which was the greatest, submerged the land to a minimum of 1,500 feet below its present level—in Wales at least—and was doubtless general. The post-glacial shells of Moel Tryfane and those by the Ribble, indicating ancient beaches, belong to this period. During this time, and the re-emergence of the land, what the author termed the "washed drift sand" was eliminated from, sorted, and reformed out of, the boulder drift, and scattered over the country, but has since been much denuded by atmospheric and aqueous or sub-aërial influences above the 25 feet contour, and by sub aërial and submarine denudation below that line. 3. A re-emergence of the land took place, and a land-pause favourable to growth occurred, during which time the "inferior peat and forest beds," or sub-terrene land surfaces, were formed. At the period of pause the land would be higher than now, but the vertical extent of this movement the author purposed investigating hereafter. 4. A second period of subsidence again followed, and a pause occurred at or about the 25 feet contour line. "The Formby and Leasowe marine beds" were now laid down. 5. A second or latest vertical upward movement followed, elevating the Formby and Leasowe marine beds, upon which now grew the forest trees, the remains of which assist to form the "superior peat bed" extending along the coast margin from the river Douglas to Bootle in Lancashire, and from the Mersey to the Dee in Cheshire, and remains of which are found as high up the river Mersey as Garston and Warrington. 6. The third or latest downward movement now took place, and during this time the river bed at Crossens was silted up, as also the Garston Creek. The drainage was obstructed, and the beds of marine silt intercalated in the peat. The tidal silt overlying the superior peat bed by the Douglas, the Alt, and the Birket, the silt which overlay the peat bed of Old Wallasey Pool, and that in which the vertebræ of a whale, now in Brown's Museum, were discovered at the North Docks, and all the deposits to which the author confined the term recent, belong to this period, in a pause of which we are now living. 7. That the whole of these movements were uniform over a far more extensive area than the author has investigated, he has not the shadow of a doubt. That post-glacial movements were slow is almost universally admitted, and from these the inference is obvious that the time which they measure compared with the historical period is so vast that it is difficult to form an adequate conception of it.

Norwich

Norfolk and Norwich Naturalists' Society, October 31.—Mr. J. E. Taylor read a paper on "The Origin of the Norfolk Broads and Meres." With regard to the former, Mr. Taylor propounded the theory that the depressions, so-called, were owing to the influence of ice in remote ages, and that the basins thus scooped out had been since filled up by the growth of peat and the soil brought down by floods. His views were supported by an elaborate essay upon the probable condition of the European continent at the close of the glacial epoch, and the alterations effected by "the last geological change in its physical scenery and geography," as illustrated by the deep lakes of "Switzerland, Scotland, Cumberland, &c., hollowed out of the solid rocks by glacier action." He specially referred also to the great similarity in the physical aspect of the Dutch coast as compared with the Broad district of our eastern counties. Broads, he remarked, were distinguished from meres by being always in connection with rivers, and having a chalky bottom, more or less filled in with deposits of mud. Meres, on the contrary, in their physical characters, presented an almost entire separation from rivers and streams, "and the fact that they usually lie in the upper boulder clay, and therefore at a considerably higher level than the broads. The water supply of meres was simply the storage of wet seasons." The number of broads on the Bure and its tributaries, amounting in all to twenty-two, as compared with but four on the Yare, he attributed to the former stream having an average breadth of 150 feet, and the latter of only 100 feet. The formation of Diss Mere he considered due to glacial action, "as the neighbourhood abounded in evidences of such phenomena."—Mr. J. H. Gurney, jun., exhibited a male specimen of White's Thrush (*Oreocincla aurea*), killed on the 10th October last, by Mr. F. Barrett, in a marsh at Hickling, and exhibited by permission of the Rev. J. Micklethwaite, for whose collection it is being preserved by Mr. T. E. Gunn. Mr. Gurney pointed out the distinctions between the closely allied genera of *Oreocincla*, *Turdus*, and *Merula*, and made some remarks on *O. aurea* as a British species. It is, he said, the *Turdus Whitei* of Egton, and of Yarrell's "British Birds," so called after the well-known naturalist of Selbourne, and has been killed in six or seven instances in this country, the specimen exhibited being the first recognised as occurring in this country. It is found in China, and is said to have been met with in Siberia.—Mr. Barrett exhibited specimens of *Zygæna exulans*, a Swedish moth recently taken in Scotland.

Dublin

Royal Irish Academy, December 11.—Prof. Henry Hennessy, F.R.S., vice-president, in the chair. Prof. Robert S. Ball read two notes on applied mechanics. In the first note it was demonstrated that in whatever manner a figure moves in a plane, a number of points, lying on the circumference of a circle, are any instant in points of inflexion of the curves which they describe, and that the points of the circle are at points the tangent to which meets the curve in four consecutive points. These theorems embrace what are known in mechanics as the parallel motions. The second note contained an elegant geometrical construction by which the consecutive points of contact of two curves are determined.—The Secretary then read a paper by Mr. Hodder M. Westropp, in which the writer stated that he had abandoned his former theory that the Ogham inscriptions had a Danish origin, and now suggested that after all the learned interpretations that had been attempted of their meaning, they were nothing more than notches made to mark the number of cattle possessed by the owner of a plot of land at the annual division which took place under the ancient Brehon

laws of Ireland. It was simply a rudimentary scoring of numbers, such as had taken place amongst all nations in the earliest stages of civilisation. There was no substantial reason for attributing to the Irish, who, even at the time of Giraldus Cambriensis, had scarcely emerged from barbarism, the formation of an alphabet, and the attempts to decipher the inscriptions by attributing to them an alphabetic character were simply absurd. Dr. Ferguson, Q.C., said he was sure that if Mr. Westropp knew anything of the circumstances in which these inscriptions were found he would not have put forward such a theory. One of the very examples to which he referred in his paper proved the inaccuracy of his statement that these stones had not been found in connection with gravel. It was quite evident that in his illustrations he had worked from very imperfect copies, for his illustrations misrepresented the inscriptions. This was a case of a wild theory started without a fact being adduced in support of it.

Royal Geological and Zoological Societies of Ireland.—A joint meeting of these societies was held on Wednesday, the 13th of December, 1871, William Ogilby, M.A., F.G.S., in the chair. W. H. Baily, F.L.S., read some additional notes on the Fossil Flora of Ireland. The author first described a new fossil plant from shale in the carboniferous limestone of Whitestone Quarry, near Wexford, under the name of *Filicites plumiformis*. He then gave the results of his examination of the collections made from upper Old Red sandstone strata at Kiltorcan, Co. Kilkenny, which collections had excited considerable attention among the Continental and American botanists, and brought forward some strong facts to prove that the Irish palæontologists had not misled Prof. Heer, as stated by Mr. Carruthers at a recent meeting of the London Geological Society.—Prof. Traquair read some notes on the genus *Phaneropleuron*.

VIENNA

I. R. Geological Institution, November 21.—The Director, Fr. Ritt. v. Hauer, read the anniversary report on the progress made by the Institute. The surveyors were occupied in the course of the last year on two different regions; the military frontier, where the geological maps of the country between Brod in Slavonia, and the shore of the Adriatic were finished, and Tyrol, where parts of the crystalline central mountain region and of the northern limestone ranges were surveyed. At the request of private proprietors, the members of the Institute were occupied besides with particular inquiries as to the nature and extent of coal-seams, strata and veins of ores and other useful minerals in almost all parts of the empire, and a very accurate examination of the rocks which are to be perforated by the Arlberg Tunnel, between Tyrol and Varalberg, was made by M. H. Wolf. In the museum of the Institute the larger collections of minerals from the different mining districts of the empire were completely re-arranged, and a magnificent collection of fossil Mammalia, from the tertiary brown coal of Eibiswald in Styria, was exposed under glass. More than forty different persons have contributed by donations to the increase of the various collections. In the Chemical Laboratory more than 100 analyses and assays have been performed for about fifty parties. A new arrangement of the library was finished in the course of the year; with the end of 1870 it numbered 6,500 different works, with about 16,500 volumes; in the first ten months of 1871 the increase amounted to more than 12,000 volumes. The collection of Maps (besides those which were made by the Institute itself) consisted, at the end of 1870, of 2,850 sheets, and has since increased by nearly 300 sheets. The publications of the Institute were enlarged by a new periodical, the "Mineralogischen Mittheilungen," which is edited by Dr. G. Tschermak, the director of the Imperial Mineralogical Museum; they appear separately as well as in the form of a supplement to the "Jahrbuch." The publication of the memoirs ("Abhandlungen") of the Institute, which had been interrupted, was also recommenced this year by the publication of two memoirs: one by Dr. Neumayer, "On the Cephalopods of the Jurassic Beds of Balin, near Krakaw;" the other by Dr. Bunzel, "On the Vertebrata of the Cretaceous Formation of Grünbach in Austria." Of the general geological map of Austria, edited by Fr. v. Hauer, appeared sheet No 3 (the northern Carpathians), and the printing in colours of sheet No. 7 (the Hungarian plain) was finished. Dr. Neumayer noticed the discovery of the salt formation in the valley of Hall in Tyrol, at a point far below the salt mines now being worked. Here the mining work would meet with considerably less difficulty, arising from the great height of the old mine (5,000 feet above the level of the sea) the access to which in winter time is always dangerous, often even impossible.—M. Chanl. v. Hauer read a note on a very successful boring for coal in the tertiary basin near Fohnsdorf in Styria. On the northern edge of this basin, many years since, a large seam of coal had been worked. The bore-hole had been opened in the midst of the basin, 300 fathoms from the nearest point of the mine. At the depth of 155 fathoms the coal was reached in two seams, having together a thickness of 5½ fathoms. This discovery is of great importance for the industry of Upper Styria.—Dr. E. Tietze "On the Eocene Formation south of Glina, in Croatia." It consists of three members; the lowest a fresh-water deposit, with Planorbis, and traces of coal; the middle, green sandstones alternating with marly beds, probably identical with the so-called Albarese or Galestro of the Appennine mountains; and the upper, formed of slaty sandstones with fucoids.

DIARY

THURSDAY, DECEMBER 28.

ROYAL INSTITUTION, at 3.—On Ice, Water, Vapour, and Air. No. I. Prof. John Tyndall, F.R.S.

LONDON INSTITUTION, at 4.—The Philosophy of Magic. 2. The Magic of the Theatre: J. C. Brough, F.C.S.

SATURDAY, DECEMBER 30.

ROYAL INSTITUTION, at 3.—On Ice, Water, Vapour, and Air. No. II. Prof. John Tyndall, F.R.S.

MONDAY, JANUARY 1.

ANTHROPOLOGICAL INSTITUTE, at 8.—On the Hereditary Transmission of Endowments: George Harris.—The Adamites: C. Staniland Wake.

TUESDAY, JANUARY 2.

ZOOLOGICAL SOCIETY, at 9.

SOCIETY OF BIBLICAL ARCHÆOLOGY, at 8.30.—Hebræo Ægyptiaca; or, Hebrew and Egyptian Analogies: M. Francois Chabas.—Some Observations upon the Inscription of Daly (Idalion): S. Birch, F.S.A.

WEDNESDAY, JANUARY 3.

MICROSCOPICAL SOCIETY, at 8.—Fossils of the Coal Measures; W. Carruthers, F.R.S.—Fermentation and its results: James Bell.

THURSDAY, JANUARY 4.

LONDON INSTITUTION, at 4.—The Philosophy of Magic. 3. The Magic of the Mediums: J. C. Brough, F.C.S.

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